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2 vols

A

NATURAL HISTORY,

GENERAL AND PARTICULAR;

CONTAINING THE

HISTORY AND THEORY OF THE EARTH,

A GENERAL HISTORY OF MAN,

THE BRUTE CREATION, VEGETABLES, MINERALS, &c. &c.

BY GEORGE LOUIS LE CLERC, COUNT OF BUFFON.

TRANSLATED FROM THE FRENCH

BY WILLIAM SMELLIE,

MEMBER OF THE ANTIQUARIAN AND ROYAL SOCIETIES OF EDINBURGH.

A NEW EDITION CORRECTED AND ENLARGED.

TO WHICH IS ADDED

A HISTORY

OF

BIRDS, FISHES, REPTILES, AND INSECTS,

EMBRACING THE

RECENT DISCOVERIES OF EMINENT NATURALISTS;

TOGETHER WITH AN

ACCOUNT OF THE MOST CURIOUS FOREIGN PLANTS.

BY HENRY AUGUSTUS CHAMBERS, LL. D.

VOL. I.

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TO THE

COUNT OF BUFFON.

&c. &c. &c.

SIR,

YOU did me honour by permitting me to address to you my translation of your illustrious work; and I am proud to exercise the privilege you so politely conferred upon me. The important information it contains, and the eloquence of its composition, joined to the ingenuity, taste, and erudition with which it abounds, induced me to think that a version of it into the English language, by diffusing the knowledge of nature, would increase the number of her admirers. The task, it must be acknowledged, was arduous; but your approbation and encouragement, by redoubling my vigour, diminished the difficulty of the labour.

It was with the liveliest pleasure that I received your communications respecting the valuable performances you have already published, and concerning those great undertakings which now engage your attention. I failed not to announce to your friends in this country the advantages which science and literature have yet to expect from you; and I need hardly observe, that their wishes and my own, for the accomplishment of your purposes, are in proportion to the greatness of your talents.

The success which the translation has met with, I impute to the celebrity of your name, and to the high value of the original.

I have the honour to be, with the most entire respect, Sir,

Your most obedient and most humble servant,

EDIN. May 10, 1781. *WILLIAM SMELLIE.*

LIFE

OF

GEORGE LOUIS LE CLERC, COUNT OF BUFFON.

George Louis le Clerc, count Buffon, a naturalist and writer of great eminence, was the son of a counsellor of the parliament of Dijon, at whose seat at Montbard in Burgundy he was born, September 7, 1707. He manifested an early inclination to the sciences, which diverted him from pursuing the profession of the law, to which his first studies at Dijon were devoted, and to which his father designed him. The science which seems to have engaged his earliest attachment was astronomy; with a view to which he applied with such ardour to the study of geometry, that he always carried in his pocket the Elements of Euclid.

At the age of twenty he travelled into Italy, where the objects of his curiosity were less the productions of art than the phenomena of nature, to the study of which he devoted all his faculties. At this early period, however, he was ambitious of acquiring the art of writing with ease and elegance, justly thinking that eloquence imparted additional lustre to the attractions of truth. He succeeded at twenty-one to a handsome property; and, after concluding his travels with a visit to England, he commenced a life of ease and literature, divided between Paris and his estate at Montbard. His first publication was a translation from the English of Hales's Vegetable Statics, in 1735; followed, in 1740, by a translation from the Latin, of Newton's Fluxions. He was appointed, in 1739, superintendant of the royal garden and cabinet, which, as he came to be known, he enriched with the productions of all the parts of the world. To the advantages of the situation he enjoyed, he added the essential quality of industry, and is said to have passed fourteen hours every day in study. This, however, must have been in his intervals of country retirement, since he was fond of society, and was by no means insensible to the attractions of the fair sex. Of his great application, however, he gave a convincing proof by the publication of his celebrated work, "Natural History, general and particular," which commenced in 1749; and was completed in 1767.

He begins with a theory of the earth, which, with the other planets, he supposes to have been originally a mass of liquefied matter, dashed out of the body of the sun by the violent illapse of a comet. He then covers it with ocean, from which he forms strata by deposition, and mountains by the flux and reflux of the tide. Subterraneous fires, eruptions, and earthquakes, effect other changes; and the world we now inhabit is but the ruins of a former world.

Buffon's theory of the earth obtained repute by his grand views and striking descriptions, and will for ever remain a brilliant display of eloquence, combined with profound and extensive information. Proceeding to the population of the earth with living creatures, he considers the analogies between vegetable and animal life. He first traces the progress of man from his cradle to his grave, and developes the laws of that constant correspondence between the physical changes of his senses or organs, and those which operate on the understanding or on the passions. He teaches us to know the mechanism of our senses, their relations with our sensations or our ideas, the errors to which they expose us, the manner in which we learn to see, to touch, to understand, and how the child, whose feeble and uncertain eyes that behold only a confused mass of colours, attains by habit and reflection, to seize in a single glance the extent of a vast horizon, and even to the power of creating and combining images. With what curiosity we observe those details which relate to the most lively of our pleasures and the most delightful of our sentiments, those secrets of nature and of modesty, to which the majesty of style and the severity of thought impart decency and decorum, and a sort of philosophic dignity, and which wisdom may contemplate without a blush.

He then investigates and unfolds the nature of brute animals in general; and marks the distinction between them, and men, by denying them a soul and memory properly so called, and making all their actions spring from external impressions. It is hardly necessary to remark, that he adopts his style to the particular subjects of his discussion. Whilst the mere enumeration of facts, or description of the figure, dimensions, and colours of animals, admit of no other ornament than perspicuity, topics of philosophy and argument require a higher and more figurative expression; and, addressed to the passions and finer feelings of men, allow full scope to the exercise of genius and of taste. Of these, different species of writing, the works of Buffon, afford numerous examples. It has, however, been judiciously observed, that his style occasionally rises above the level of the subject; and this is particularly the case when he is painting in glowing colours the manners and habits of the lion, the horse, the elephant, and of his favourite subjects. By the indulgence of this passion for high painting, he has sometimes been betrayed into a deviation from the limits of simple truth, and has been led to wander into the regions of fancy. In particular and minute observation he excels, and by his indefatigable researches he has made a very copious addition to the treasury of authenticated facts.

In 1774, he began to publish a Supplement to his Natural History, consisting of the History of Minerals. The first volume of this work contains his remarkable invention of a burning glass, composed of a number of plane mirrors, so disposed as to throw all their reflexions of the solar beams on the same spot. He constructed an instrument of this kind, consisting of 360 plane mirrors, each capable of being separately adjusted by a screw, with which he kindled wood at the distance of 210 feet, thus realising what has been related of Archimedes at the siege of Syracuse. These supplemental volumes, of which the fifth, quarto, appeared in 1779, contain many curious and valuable experiments, as well as much theory.

Convinced of the importance of religion in maintaining the due subordinations of society, he always paid it external respect, and regularly performed its public duties; and thus he flattered himself that he avoided sharing in the mischievous attacks which Voltaire, Diderot, and others, had made upon religion. He was very regular in the distribution of his time, and passed a life of great industry. Composing was a difficult task to him, and his writings passed through a number of revisals before they were made public. Indeed style was one of the capital objects of his admiration. He could not bear the least deviation from accuracy and propriety in the use of language, and hence was a severe censor of poetry, which he had attempted in his youth, but soon quitted for prose. A nice and just regard to his fame made him destroy every paper which he thought useless or unfinished, so that he left behind him none of the rubbish which crowds the desks of so many great authors, and furnishes matter for posthumous degradation. In reading his writings to others, of which he was fond, if he discovered that the hearer was the least embarrassed about the meaning of a passage, he directly altered it; and he paid ready attention to every critical remark. When he had made many corrections in a manuscript, he employed an amanuensis to transcribe it, and then he would correct it again. He told M. de Séchelles, that the *Etudes de la Nature* were written over eighteen times. He spoke with rapture of the pleasures derived from literature; and he preferred the books, to the conversation of learned men, the latter of which, he said, had almost always disappointed him. Hence he himself rarely attempted more than to trifle in company. He maintained a correspondence with several persons of rank and eminence, among whom one of the greatest in every view was the late empress of Russia, who ably criticised some of his opinions, and favoured with great zeal in her dominions his researches in natural history. Notwithstanding great sufferings from the stone and gravel, his life was prolonged to his eighty-first year, dying on April 16th, 1788, in the full possession of his senses. His funeral at St. Medard's was attended by a great concourse of academicians and persons of rank and literary distinction. He left one son, who fell a victim to the atrocities under Robespierre.

In the reveries of Buffon, says an ingenious writer in the Monthly Review, there is entertainment, and always instruction, of some kind or other. The principal works of this great author have been published together in thirty-five vols. 4to. and sixty-two vols. 12mo. They are received among the standard and classic books of the nation, and new editions of them are at this time under publication. Buffon was a member of the French academy, and was perpetual treasurer of the academy of sciences. He wisely stood apart from the intrigues and parties which so disgracefully occupied most of the French literati of his time; and probably for the preservation of his tranquillity, he made a point never to reply to the attacks upon his works, though some of his antagonists could by no means be deemed unworthy of his notice. In 1771 his estate of Buffon was erected into a comté; and thus the decoration of rank, to which he was by no

means indifferent, was added to the superior dignity he had acquired as one of the most distinguished members of the republic of letters.

Such was his ardour for study in the early part of his life, that we learn from the biographical anecdotes relating to him, collected by Herault de Sechelles, and published in M. Peltier's "Paris pendant l'Année 1795 et l'Année 1796," that he would sometimes return from the suppers at Paris at two in the morning, and order a boy to call him at five; and if he lingered in bed, to drag him on the floor. At this early hour it was his custom, at Montbard, to dress, dictate letters, and regulate his domestic concerns; he then, at six, retired to his study, which was a pavilion called the tower of St. Louis, about a furlong from the house, at the extremity of the garden, and which was accommodated only with an ordinary wooden desk and an arm chair. Within this was another sanctuary, denominated by Prince Henry of Prussia, "The Cradle of Natural History," in which he was accustomed to compose. On this retreat no one was suffered to intrude. At nine his breakfast, which consisted of two glasses of wine and a bit of bread, was brought to his study; and, after breakfast, he wrote for above two hours, and then returned to his house. After dinner, during which he indulged in lively and free conversation, he usually slept about an hour, then took a solitary walk, and employed the evening either in examining papers submitted to his judgment, or in conversation with his friends. This kind of life he passed for 50 years; and to one who expressed astonishment at his great reputation, he hastily replied, "Have I not spent 50 years at my desk?"

His figure was noble and manly, and his countenance, even in advanced age, and notwithstanding excruciating pains which deprived him of sleep sometimes for sixteen successive nights, was calm and placid, and exhibited traces of superior intelligence. He was particularly fond of having his hair neatly dressed, and for this purpose he employed the friseur, in old age, twice or thrice a day. To his dress he was peculiarly attentive; and took pleasure in appearing on Sundays before the peasantry of Montbard in laced clothes.

THE HISTORY AND THEORY OF THE EARTH.

The figure of the earth, (see subsequent proofs of the theory of the earth, art. I.) its motions, or the external relations which subsist between it and the other parts of the universe, belong not to our present inquiry. It is the internal structure of the globe, its form and manner of existence, which we here propose to examine. The general history of the earth ought to precede that of its productions. Details of particular facts relating to the œconomy and manners of animals, or to the culture and vegetation of plants, are not, perhaps, so much the objects of natural history, as general deductions from the observations that have been made upon the different materials of which the earth itself is composed; as its heights, depths, and inequalities; the motions of the sea, the direction of mountains, the situation of rocks and quarries, the rapidity and effects of currents in the ocean, &c. This is the history of Nature at large, and of her principal operations, by which every other inferior or less general effect is produced. The theory of these effects constitutes what may be called the primary science, upon which a precise knowledge of particular appearances, as well as of terrestrial substances, solely depends. This species of science may be considered as appertaining to physics; but, is not all physical knowledge, where system is excluded, a part of the history of nature?

In subjects of an extensive kind, the relations of which it is difficult to trace, where some facts are but partially known, and others obscure, it is more easy to form a fanciful system than to establish a rational theory. Thus the theory of the earth has never hitherto been treated but in a vague and hypothetical manner. I shall, therefore, exhibit a cursory view only of the notions of some authors who have written upon this subject.

The first hypothesis I shall mention is more conspicuous for its ingenuity than solidity. It is the production of an English astronomer (Whiston; see the proofs, art. II.) who was an enthusiastic admirer of Sir Isaac Newton's system of philosophy. Convinced that every possible event depends upon the motions and direction of the stars, he endeavours to prove, by means of mathematical calculations, that all the changes this earth has undergone have been produced by the tail of a comet.

For another hypothesis we are indebted to a heterodox divine (Burnet; see proofs, art. III.) whose brain was so fully impregnated with poetical illusions, that he imagined he had seen the universe created. After telling us the state of the earth when it first sprung from nothing, what changes have been introduced by the deluge, what the earth has been, and what it now is, he assumes the prophetic style, and predicts what will be its condition after the destruction of the human kind.

A third writer, (Woodward; see proofs, art. IV.) a man of more extensive observation than the two former, but equally crude and confused in his ideas, explains the principal appearances of the globe by the aid of an immense abyss in the bowels of the earth, which, in his estimation, is nothing but a thin crust inclosing this vast ocean of fluid matter.

These hypotheses are all constructed on tottering foundations. The ideas they contain are indistinct, the facts are confounded, and the whole is a motley jumble of physics and fable. They, accordingly, have never been adopted but by men who embrace opinions without examination, and who, incapable of distinguishing the degrees of probability, are more deeply impressed with marvellous chimeras than with the genuine force of truth.

My ideas on this subject will be less extraordinary, and may even appear unimportant, when compared with the grand systems of such hypothetical writers. But it should not be forgotten, that it is the business of an historian to describe, not to invent; that no gratuitous suppositions are to be admitted in subjects which depend upon fact and observation; and that, in historical compositions, the imagination cannot be employed, except for the purpose of combining observations, of rendering facts more general, and of forming a connected whole, which presents to the mind clear ideas, and probable conjectures: I say, probable; for it is impossible to give demonstrative evidence on this subject. Demonstration is confined to the mathematical sciences. Our knowledge in physics and natural history depends entirely on experience, and is limited to the method of reasoning by induction.

With regard to the history of the earth, therefore, we shall begin with such facts as have been universally acknowledged in all ages, not omitting those additional truths which have fallen within our own observation.

The surface of this immense globe exhibits to our observation heights, depths, plains, seas, marshes, rivers, caverns, gulfs, volcanos; and, on a cursory view, we can discover, in the disposition of these objects, neither order nor regularity. If we penetrate into the bowels of the earth, we find metals, minerals, stones, bitumens, sands, earths, waters, and matter of every kind, seemingly placed by mere accident, and without any apparent design. Upon a nearer and more attentive inspection, we discover sunk mountains, (see Senec. Quæst. lib. 6. cap. 21. Strab. Geog. lib. 1. Orosius, lib. 2. cap. 18. Plin. lib. 2. cap. 19. Hist. de l'Acad. des Sciences, année 1708, p. 23.) caverns filled up, shattered rocks, whole countries swallowed up, new islands emerged from the ocean, heavy substances placed above light ones, hard bodies inclosed within soft bodies; in a word, we find matter in every form, dry and humid, warm and cold, solid and brittle, blended in a chaos of confusion, which can be compared to nothing but a heap of rubbish, or the ruins of a world.

These ruins, however, we inhabit with perfect security. The different generations of men, of animals, and of plants, succeed one another without interruption: The productions of the earth are sufficient for their sustenance; the motions of the sea, and the currents of the air, are regulated by fixed laws; (see the proofs, art. XIV.) the returns of the season are uniform, and the rigours of winter invariably give place to the verdure of the spring. With regard to us, every thing has the appearance of order: The earth, formerly a chaos, is now a tranquil, an harmonious, a delightful habitation, where all is animated and governed by such amazing displays of power and intelligence, as fill us with admiration, and elevate our minds to the contemplation of the great Creator.

But let us not decide precipitantly concerning the irregularities on the surface of the earth, and the apparent disorder in its bowels: We shall soon perceive the utility, and even the necessity of this arrangement. With a little attention, we shall perhaps discover an order of which we had no conception, and general relations that cannot be apprehended by a slight examination. Our knowledge, indeed, with regard to this subject, must always be limited. We are entirely unacquainted with many parts of the surface of this globe, (see proofs, art. VI.) and have partial ideas only concerning the bottom of the ocean, which, in many places, has never been sounded. We can only penetrate the rind of the earth. The greatest caverns, (Phil. Trans. abridged, vol. ii. p. 323.) the deepest mines, (Boyle's Works, vol. iii. p. 232.) descend not above the eight thousandth part of its diameter. Our judgment is therefore confined to the upper stratum, or mere superficial part. We know, indeed, that, bulk for bulk, the earth is four times heavier than the sun: We likewise know the proportion its weight bears to that of the other planets. But still this estimation is only relative. We have no standard. Of the real weight of the materials we are so ignorant, that the internal part of the globe may be either a void space, or it may be composed of matter a thousand times heavier than gold. Neither is there any method of making farther discoveries on this subject. It is even with difficulty that rational conjectures can be formed, (see proofs, art. 1.)

We must therefore confine ourselves to an accurate examination and description of the surface of the earth, and of such inconsiderable depths as we have been able to penetrate. The first object which attracts attention, is that immense collection of waters with which the greatest part of the globe is covered. These waters occupy the lowest grounds; their surface is always level; and, notwithstanding their uniform tendency to equilibrium and rest, they are kept in perpetual agitation by a powerful agent, (proofs, art. XII.) which counteracts their natural tranquillity, which communicates to them a regular periodic motion, alternately elevating and depressing their waves, and which produces a concussion or vibration in the whole mass, even to the most profound depths. This motion of the waters is coeval with time, and will endure as long as the sun and moon, by which it is produced.

In examining the bottom of the sea, we perceive it to be equally irregular as the surface of the dry land, (proofs, art. XIII.) We discover hills and valleys, plains and hollows, rocks and earths of every kind, (see M. Buache's chart of the depths of the ocean between Africa and America.) We discover, likewise, that islands are nothing but the summits of vast mountains, whose foundations are buried in the ocean; (Varenii Geog. gen. p. 218.) we find other mountains whose tops are nearly on a level with the surface of the water; and rapid currents which run contrary to the general movement, (proofs, art. XIII.) These currents sometimes run in the same direction; at other times their motion is retrograde; (Varen. p. 140, and Voyages de Pirard, p. 137.) but they never exceed their natural limits, which seem to be as immutable as those which bound the efforts of land rivers. On the one hand, we meet with tempestuous regions, where the winds blow with irresistible fury, where the heavens and the ocean, equally convulsed, are mixed and confounded in the general shock; violent intestine motions, tumultuous swellings, (Shaw's Travels), water-spouts, (proofs, art. XVI.) and strange agitations, produced by volcanos, whose mouths, though many fathoms below the surface, vomit forth torrents of fire, and push, even to the clouds, a thick vapour, composed of water, sulphur, and bitumen; and dreadful gulphs or whirlpools, [the Male-

stroom in the Norwegian sea,] which seem to attract vessels for no other purpose than to swallow them up. On the other hand, we discover vast regions of an opposite nature, always smooth and calm, but equally dangerous to the mariner, [the calms and tornados in the Æthiopian sea.] Here the winds never exert their force; the nautical art is of no utility; the becalmed voyagers must remain immoveably fixed, till death relieve them from misery. To conclude, directing our eyes towards the southern or northern extremities of the globe, we discover huge masses of ice, (proofs, art. VI. and X.) which, detaching themselves from the polar regions, advance, like floating mountains, to the more temperate climates, where they dissolve and vanish from our view, (see Buache's chart, 1739.)

Beside these grand objects, the ocean presents us with myriads of animated beings, almost infinite in variety: Some, clothed in light scales, swim with amazing swiftness; others, loaded with thick shells, trail heavily along, leaving their traces in the sand: To others nature has given fins resembling wings, with which they support themselves in the air, and fly before their enemies to considerable distances. Lastly, the sea gives birth to other animals, which, totally deprived of motion, live and die immoveably fixed to the same rocks: all, however, find abundance of food in this fluid element. The bottom of the ocean, and the shelving sides of the rocks, produce plentiful crops of plants of many different species; its soil is composed of sand, gravel, rocks, and shells; in some places, it is a fine clay, in others, a compact earth; and, in general, the bottom of the sea has an exact resemblance to the dry land which we inhabit.

Let us next take a view of the land: What prodigious differences take place in different climates! What a variety of soils! What inequalities in the surface! But, upon a more attentive observation, we shall perceive, that the great chains of mountains lie nearer the equator than the poles, (proofs, art. IX.) that, in the Old Continent, their direction is more from east to west than from south to north; and that, on the contrary, in the New Continent, they extend more from north to south, than from east to west. But, what is still more remarkable, the figure and direction of these mountains, which have a most irregular appearance, (proofs, art. IX. XII.) correspond so wonderfully, that the *prominent* angles of one mountain are constantly opposite to the *concave* (*Saliant* and *re-entering* angles; Muller's Fortification,) of the neighbouring mountain, (Lettres Phil. de Bourguet, p. 181,) and of equal dimensions, whether they be separated by an extensive plain, or a small valley. I have further remarked, that opposite hills are always nearly of the same height; and that mountains generally occupy the middle of continents, islands, and promontories, dividing them by their greatest lengths, (Varen. Geog. p. 69.) I have likewise traced the courses of the principal rivers, and find that their direction is nearly perpendicular to the sea-coasts into which they empty themselves; and that, during the greatest part of their courses, they follow the direction of the mountains from which they derive their origin, (proofs, art. X.) The sea-coasts are generally bordered with rocks of marble and other hard stones, or rather with earth and sand accumulated by the waters of the sea, or brought down and deposited by rivers. In opposite coasts, separated only by small arms of the sea, the different strata or beds of earth are of the same materials, (proofs, art. VII.) I find that volcanos never exist but in high mountains; (proofs, art. XVI.) that a great number of them are entirely extinguished; that some are connected with others by subterranean passages, and their eruptions not unfrequently happen at the same time, (Kircher Mund. subter. in præf.) There are similar communications between certain lakes and seas. Some rivers suddenly disappear, (Varen. Geog. p. 43.) and seem to precipitate themselves into the bowels of the earth. We likewise find certain mediterranean or inland seas, which constantly receive, from many and great rivers, prodigious quantities of water, without any augmentation of their bounds, probably discharging by subterraneous passages, all these extraneous supplies. It is likewise easy to distinguish lands which have been long inhabited, from those new countries where the earth appears in a rude state, where the rivers are full of cataracts, where the land is either nearly overflowed with water or burnt up with drought, and where every place capable of producing trees is totally covered with wood.

Proceeding in our examination, we discover that the upper stratum of the earth is universally the same substance, (proofs, art VII.) that this substance, from which all animals and vegetables derive their growth and nourishment, is nothing but a composition of the decayed parts of animal and vegetable bodies, reduced into such small particles that their former organic state is not distinguishable. Penetrating a little deeper, we find the real earth, beds of sand, lime-stone, clay, shells, marble, gravel, chalk, &c. These beds are always parallel to each other, (proofs, and Woodward, p. 41. &c.) and of the same thickness through their whole extent. In neighbouring hills, beds or strata of the same materials are uniformly found at the same levels, though the hills be separated by deep and large valleys. Strata of every kind, even of the most solid rocks, are uniformly divided by perpendicular fissures, (proofs, art. VIII.) Shells, skeletons of fishes, marine plants, &c. are often found in the bowels of the earth, and on the tops of mountains, (proofs, art. VIII.) even at the greatest distances from the sea. These shells, fishes, and plants, are exactly similar to those which exist in the ocean. Petrified

shells are to be met with, almost every where, in prodigious quantities: they are not only inclosed in rocks of marble and lime-stone, as well as in earths and clays, but are actually incorporated and filled with the very substances in which they are inclosed. In fine, I am convinced, by repeated observation, that marbles, lime-stones, chalks, marles, clays, sand, and almost all terrestrial substances, wherever situated, are full of shells, and other spoils of the ocean, (Steno, Woodward, Ray, Bourguet, Scheuchzer, Phil. Trans. Mem. de l'Acad. &c.)

Having enumerated these facts, let us try what conclusions can be drawn from them.

The changes which the earth has undergone, during the last two or three thousand years, are inconsiderable, when compared with the great revolutions which must have happened in those ages that immediately succeeded creation. For, as terrestrial substances could only acquire solidity by the continued action of gravity, it is easy to demonstrate, that the surface of the earth was at first much softer than it is now; and, consequently, that the same causes, which at present produce but slight and almost imperceptible alterations during the course of many centuries, were then capable of producing very great revolutions in a few years. It appears, indeed, to be an incontrovertible fact, that the dry land, which we now inhabit, and even the summits of the highest mountains, were formerly covered with the waters of the sea; for shells, and other marine bodies, are still found upon the very tops of mountains. It likewise appears, that the waters of the sea have remained for a long track of years upon the surface of the earth; because, in many places, such immense banks of shells have been discovered, that it is impossible so great a multitude of animals could exist at the same time. This circumstance seems likewise to prove, that, although the materials on the surface of the earth were then soft, and of course easily disunited, moved, and transported, by the waters; yet these transportations could not be suddenly effected. They must have been gradual and successive, as sea-bodies are sometimes found more than 1000 feet below the surface. Such a thickness of earth or of stone could not be accumulated in a short period. Although it should be supposed, that, at the deluge, all the shells were transported from the bottom of the ocean, and deposited upon the dry land; yet, beside the difficulty of establishing this supposition, it is clear, that, as shells are found incorporated in marble and in the rocks of the highest mountains, we must likewise suppose, that all these marbles and rocks were formed at the same time, and at the very instant when the deluge took place; and that, before this grand revolution, there were neither mountains, nor marbles, nor rocks, nor clays, nor matter of any kind, similar to what we are now acquainted with, as they all, with few exceptions, contain shells, and other productions of the ocean. Besides, at the time of the universal deluge, the earth must have acquired a considerable degree of solidity, by the action of gravity for more than sixteen centuries. During the short time the deluge lasted, therefore, it is impossible that the waters should have overturned and dissolved the whole surface of the earth, to the greatest depths that mankind have been able to penetrate.

But, not to insist longer on this point, which shall afterwards be more fully canvassed, I shall confine myself to known and established facts. It is certain, that the waters of the sea have, at some period or other, remained for a succession of ages upon what we now know to be dry land; and, consequently, that the vast continents of Asia, Europe, Africa, and America, were then the bottom of an immense ocean, replete with every thing which the present ocean produces. It is likewise certain, that the different strata of the earth are horizontal, and parallel to each other, (proofs, art. VII.) This parallel situation must, therefore, be owing to the operation of the waters, which have gradually accumulated the different materials, and given them the same position that water itself invariably assumes. The horizontal position of strata is almost universal: In plains, the strata are exactly horizontal. It is only in the mountains that they are inclined to the horizon; because they have originally been formed by sediments deposited upon an inclined base. Now, I maintain, that these strata must have been gradually formed, and that they are not the effect of any sudden revolution; because nothing is more frequent than strata composed of heavy materials placed above light ones, which never could have happened, if, according to some authors, the whole had been blended and dissolved by the deluge, and afterwards precipitated. On this supposition, every thing should have had a different aspect from what now appears. The heaviest bodies should have descended first, and every stratum should have had a situation corresponding to its specific gravity. In this case, we should not have seen solid rocks or metals placed above light sand, nor clay under coal.

Another circumstance demands our attention. No cause but the motion and sediments of water could possibly produce the regular position of the various strata, of which the superficial part of this earth is composed. The highest mountains consist of parallel strata, as well as the lowest valleys. Of course, the formation of mountains cannot be imputed to the shocks of earthquakes, or to the eruptions of volcanos. Such small eminences as have been raised by volcanos or convulsions of the earth, instead of being composed of parallel strata, are mere masses of weighty materials, blended together in the utmost confusion, (proofs, art. XVII.) But this parallel and horizontal position of strata must necessa-

rily be the operation of a uniform and constant cause. We are, therefore, authorised to conclude, from repeated and incontrovertible facts and observations, that the dry and habitable part of the earth has for a long time remained under the waters of the sea, and must have undergone the same changes which are at present going on at the bottom of the ocean. To discover what has formerly happened to the dry land, let us examine what passes in the bottom of the sea; and we shall soon be enabled to make some rational conclusions with regard to the external figure, and internal constitution of the earth.

The ocean, from the creation of the solar system, has been constantly subject to a regular flux and reflux. These motions, which happen twice in twenty-four hours, are principally occasioned by the action of the moon, and are greater in the equatorial regions than in other climates. The earth likewise performs a rapid motion round its axis, and, consequently, has a centrifugal force, which is also greatest at the equator. This last circumstance, independent of actual observations, proves, that the earth is not a perfect sphere, but that it must be more elevated under the equator than at the poles. From these two combined causes, the tides, and the motion of the earth, it may be fairly concluded, that, although this globe had been originally a perfect sphere, its diurnal motion, and the ebbing and flowing of the tides, must necessarily, in a succession of time, have elevated the equatorial parts, by gradually carrying mud, earth, sand, shells, &c. from other climates, and depositing them at the equator, (proofs, art. XII.) On this supposition, the greatest inequalities on the surface of the earth ought to be, and, in fact, are found, in the neighbourhood of the equator. Besides, as the alternate motion of the tides has been constant and regular since the existence of the world, is it not evident, that, at each tide, the water carries from one place to another a small quantity of matter which falls to the bottom as a sediment, and forms those horizontal and parallel strata that every where appear? The motion of the waters, in the flux and reflux, being always horizontal, the matter transported by them must necessarily take the same parallel direction after it is deposited.

To this reasoning, it may be objected, that, as the flux is equal to, and regularly succeeded by the reflux, the two motions will balance each other; or, that the matter brought by the flux will be carried back by the reflux; and, consequently, that this cause of the formation of strata must be chimerical, as the bottom of the ocean can never be affected by a uniform alternate motion of the waters; far less could this motion change its original structure, by creating heights and other inequalities.

But, in the first place, the alternate motion of the waters is by no means equal; for the sea has a continual motion from east to west. Besides, the agitations occasioned by the winds, produce great inequalities in the tides. It will likewise be acknowledged, that, by every motion in the sea, particles of earth, and other materials, must be carried from one place, and deposited in another; and that these collections of matter must assume the form of parallel and horizontal strata. Farther, a well known fact will entirely obviate this objection. On all coasts, where the ebbing and flowing are discernible, (proofs, art. XIX.) numberless materials are brought in by the flux, which are not carried back by the reflux. The sea gradually increases on some places, and recedes from others, narrowing its limits, by depositing earth, sand, shells, &c. which naturally take a horizontal position. These materials, when accumulated and elevated to a certain degree, gradually shut out the water, and remain for ever in the form of dry land.

But, to remove every doubt concerning this important point, let us examine more closely the practicability of a mountain's being formed at the bottom of the sea, by the motion and sediments of the water. On a high coast which the sea washes with violence during the flow, some part of the earth must be carried off by every stroke of the waves. Even where the sea is bounded by rock, it is a known fact, that the stone is gradually wasted by the water; (see Shaw's Travels,) and, consequently, that small particles are carried off by the retreat of every wave. Those particles of earth or stone are necessarily transported to some distance. Whenever the agitation of the water is abated, the particles are precipitated in the form of a sediment, and lay the foundation of a first stratum, which is either horizontal, or inclined, according to the situation of the surface upon which they fall. This stratum will soon be succeeded by a similar one, produced by the same cause; and thus a considerable quantity of matter will be gradually amassed, and disposed in parallel beds. In process of time, this gradually accumulating mass will become a mountain in the bottom of the sea, exactly resembling, both in external and internal structure, those mountains which we see on the dry land. If there happened to be shells in that part of the bottom of the sea where we have supposed the sediments to be deposited, they would be covered, filled, and incorporated with the deposited matter, and form a part of the general mass. These shells would be lodged in different parts of the mountains, corresponding to the times they were deposited. Those which lay at the bottom, before the first stratum was formed, would occupy the lowest station; and those which were afterwards deposited, would be found in the more elevated parts.

In the same manner, when the bottom of the sea, at particular places, is troubled by the agitation of the waters, earth, clay, and shells, and other matter, must necessarily be removed from these parts, and deposited elsewhere. For we are assured by divers, that the bottom

of the sea, at the greatest depths to which they descend, (Boyle's works, vol. 3. p. 232.) is so strongly affected by the agitation of the water, that earth, clay, and shells, are removed to great distances. Transportations of this kind must, therefore, be constantly going on in every part of the ocean; and the matters transported, after subsiding, must uniformly raise eminences similar, in every respect, to the composition and structure of our mountains. Thus the motions produced by the flux and reflux, by winds and currents, must uniformly create inequalities in the bottom of the ocean.

Farther, we must not imagine that these matters cannot be carried to great distances, since we daily find grain, and other productions of the East and West Indies, arriving on our coasts, [particularly on the coasts of Scotland and of Ireland; see Ray's Discourses]. These bodies are, indeed, specifically lighter than water; and the other substances are specifically heavier. Still, however, as they are reduced to an impalpable powder, they may be kept long suspended in the water, and, of course, transported to any distance.

It has been conceived, that the agitation produced by the winds and tides is only superficial, and affects not the bottom, especially when it is very deep. But it ought to be remembered, that, whatever be the depth, the whole mass is put in motion by the tides at the same time; and that in a fluid globe, this motion would be communicated even to the centre. The power which occasions the flux and reflux is penetrating; it acts equally upon every particle of the mass. Hence the quantity of its force, at different depths, may be determined by calculation. Indeed, this point is so certain, that it admits not of dispute.

We cannot, therefore, hesitate in pronouncing, that the tides, the winds, and every other cause of motion in the sea, must produce heights and inequalities in its bottom; and that these eminences must uniformly be composed of regular strata, either horizontal or inclined. These heights will gradually augment; like the waves which formed them, they will mutually respect each other; and, if the extent of the base be great, in a track of years, they will form a vast chain of mountains. Whenever eminences are formed, they interrupt the uniform motion of the waters, and produce new motions, known by the name of currents. Between two neighbouring heights in the bottom of the ocean, there must be a current, (proofs, art. XIII.) which will follow their common direction, and, like a river, cut a channel, the angles of which will be alternately opposite through the whole extent of its course. These heights must continually increase; for, during the flow, the water will deposit its ordinary sediment upon their ridges, and the waters which are impelled by the current will force along, from great distances, quantities of matter, which will subside between the hills, and, at the same time, scoop out a valley with corresponding angles at their foundation. Now, by means of these different motions and sediments, the bottom of the ocean, though formerly smooth, must soon be furrowed, and interspersed with hills and chains of mountains, as we actually find it at present. The soft materials of which the eminences were originally composed, would gradually harden by their own gravity. Such of them as consisted of sandy and crystalline particles, would produce those enormous masses of rock and flint in which we find crystals and other precious stones. Others composed of stony particles mixed with shells, give rise to those beds of lime-stone and marble, in which vast quantities of sea shells are still found incorporated. Lastly, all our beds of marble and chalk have derived their origin from particles of shells mixed with a pure earth, collected and deposited at particular places in the bottom of the sea. All these substances are disposed in regular strata; they all contain heterogeneous matter, and vast quantities of sea-bodies situated nearly in proportion to their specific gravities. The lighter shells are found in chalk; the heavier in clay and lime-stone. These shells are uniformly filled with the matter in which they are found, whether it be stone or earth. This is an incontestible proof, that they have been transported along with the matter that fills and surrounds them, and that this matter was then in the form of an impalpable powder. In a word, all those substances, the horizontal situation of which has arisen from the waters of the sea, invariably preserve their original position.

It may here be objected, that most hills, the summits of which consist of solid rocks, or of marble, are founded upon small eminences, composed of less heavy materials, such as clay or light sand, the strata of which commonly extend over the neighbouring plains. If the above theory be just, what could bring about an arrangement so singular, so contrary to the laws of gravity? But this phenomenon admits of a natural and easy explication. The waters would operate first upon the upper stratum either of coasts or the bottom of the sea: this upper stratum consists generally of clay or sand; and these light substances, being carried off and deposited previous to the more dense and solid, they would of course form small eminences, and become foundations for the more heavy particles to rest upon. After the light superficial substances were removed, the harder and more ponderous would next be subjected to the attrition of the water, reduced to a fine powder and carried off and deposited above the hillocks of sand or clay. These small stony particles would, in a succession of ages, form those solid rocks which we now find on the tops of hills and mountains. As particles of stone are heavier than sand or clay, it is probable that they were originally covered and pressed by superior strata of considerable depth; but that they now occupy the highest stations, because they were last transported by the waves.

To confirm this reasoning, let us investigate more minutely the situation of those materials which compose the superficial part of the globe, the only part of which we have any adequate knowledge. The different strata of stones in quarries are almost all horizontal, or regularly inclined. Those founded upon hard clay, or other solid matter, are evidently horizontal, especially in plains. The disposition of quarries, where flint or brownish free-stone are found in detached portions is indeed less regular. But even here the uniformity of nature is not interrupted ; for the horizontal or regularly inclining position of the strata is apparent in granite and brown free-stone, wherever they exist in large connected masses. This position is universal, except in flint and brown free-stone in small detached portions, substances, the formation of which we shall demonstrate to have been posterior to those just now mentioned. The strata of granite, vitrifiable sand, clays, marbles, calcareous stones, chalk, and marls, are always parallel or equally inclined. In these the original formation is easily discoverable ; for the strata are exactly horizontal, and very thin, being placed above each other like the leaves of a book. Beds of sand, of soft and hard clay, of chalk, and of shells, are likewise either horizontal or uniformly inclined. Strata of every kind preserve the same thickness through their whole extent, which is often many leagues, and might, by proper observations, be traced still farther. In a word, the disposition of strata, as deep as mankind have hitherto penetrated, is the same.

Those beds of sand and gravel which are washed down from mountains, must, in some measure, be excepted from the general rule. They are sometimes of a considerable extent in valleys, and are situated immediately under the soil or first stratum. In plains, they are level, like the more ancient and interior strata. But near the bottom, or upon the ridges of hills, they have an inclination corresponding to that of the ground upon which they have been deposited. As these beds of sand and gravel are formed by rivers and brooks, which, especially in the valleys, often change their channe s, it is not surprising that such beds should be so frequent. A small rivulet is sufficient, in a course of time to spread a bed of sand or gravel over a very large valley. In a champaign country, surrounded with hills, whose bases, as well as the upper stratum of the plain, consisted of a hard clay, I have often observed, that, above the origin of the brooks or rivers, the clay was situated immediately under the vegetable stratum; but, in the low grounds there was a stratum of sand about a foot thick, above the clay, and extending to a great distance from the banks of the rivers. The strata formed by rivers are not very ancient ; they are easily distinguished by their frequent interruptions, and the inequality of their thickness. But the ancient strata uniformly preserve the same dimensions through their whole extent. Besides, these modern strata may be distinguished, with certainty, by the form of the stones and gravel they contain, which bear evident marks of having been rolled, smoothed, and rounded by the motion of the water. The same observation may be made with regard to those beds of turf, and corrupted vegetables, which are found in marshy grounds, immediately below the soil. They have no claim to antiquity, but have derived their existence from successive accumulations of decayed trees, and other plants. The strata of slime, or mud, which occur in many places, are also recent productions, formed by stagnating waters, or the inundations of rivers. They are not so exactly horizontal, nor so uniformly inclined, as the more ancient strata, produced by the regular motions of the sea. In strata formed by rivers, we meet with river, but seldom with sea, shells; and the few which occur are broken, detached, and placed without order? But, in the ancient strata, there are no river-shells ; the sea-shells are numerous, well preserved, and all placed in the same manner, having been transported and deposited at the same time, and by the same cause. From whence could this beautiful regularity proceed ? Instead of regular strata, why do we not find the matters composing the earth huddled together without order ? Why are not rocks, marbles, clays, marls, &c. scattered promiscuously, or joined by irregular or vertical strata ? Why are not heavy bodies uniformly found in a lower situation than light ones ? It is easy to perceive, that this uniformity of nature, this species of organization, this union of different materials by parallel strata, without regard to their weights, could only proceed from a cause equally powerful and uniform as the motions of the sea, produced by regular winds, by the tides, &c.

These causes act with superior force under the equator than in other climates; for there the tides are higher, and the winds more uniform. The most extensive chains of mountains are likewise in the neighbourhood of the equator. The mountains of Africa and Peru are the highest in the world, often extending through whole continents, and stretching to great distances under the waters of the ocean. The mountains of Europe and Asia, which extend from Spain to China, are not so elevated as those of Africa and South America. According to the relations of voyagers, the mountains of the north are but small hills, when compared with the mountains of the equatorial regions. Besides, in the northern seas, there are few islands; but in the Torrid Zone, they are innumerable. Now, as islands are only the summits of mountains, it is apparent, that there are more inequalities on the surface of the earth near the equator than in northerly climates.

Those prodigious chains of mountains which run from west to east in the Old Continent, and from north to south in the New, must have been formed by the general motion of the tides. But the origin of the less

considerable mountains and hills must be ascribed to particular motions, occasioned by winds, currents, and other irregular agitations of the sea: their formation may, indeed, be owing to a combination of all these motions, which are capable of infinite variations; for the winds, and the situation of different islands and coasts, constantly change the natural course of the tides, and oblige them to run in every possible direction. It is not, therefore, surprising to see considerable eminences which have no determined direction in their courses. But, for our present purpose, it is sufficient to have shown, that mountains have not been produced by earthquakes, or other accidental causes, but that they are effects equally resulting from the general laws of nature, as well as their peculiar structure, and the situation of the materials of which they are composed.

But how has it happened, that this earth, which we and our ancestors have inhabited for ages, which, from time immemorial, has been an immense continent, dry, compact, and removed from the reach of the water, should, if formerly the bottom of an ocean, be now exalted to such a heighth above the waters, and so completely separated from them? Since the waters remained so long upon the earth, why have they now deserted it? What accident, what cause, could introduce a change so great? Is it possible to conceive a cause possessed of power sufficient to operate such an amazing effect?

These are difficult questions. But, as the facts are incontrovertible, the precise manner in which they have happened may remain a secret, without prejudice to the conclusions that ought to be drawn from them. A little reflection, however, will furnish us at least with plausible solutions, (see proofs, art. XIX.) We daily observe the sea gaining ground on certain coasts, and losing it on others. We know, that the ocean has a general and uniform motion from east to west; that it makes violent efforts against the rocks and the low grounds which encircle it; that there are whole provinces which human industry can hardly defend from the fury of the waves; and that there are instances of islands which have but lately emerged from the waters, and of regular inundations. History informs us of inundations and deluges of a more extensive nature. Should not all these circumstances convince us, that the surface of the earth has experienced very great revolutions, and that the sea may have actually given up possession of the greatest part of the ground which it formerly occupied? For example, let us suppose, that the Old and New worlds were formerly but one continent, and that, by a violent earthquake, the ancient Atalantis of Plato was sunk. What would be the consequence of such a mighty revolution? The sea would necessarily rush in from all quarters, and form what is now called the Atlantic Ocean; and vast continents, perhaps those which we now inhabit, would, of course, be left dry. This great revolution might be effected by the sudden failure of some immense cavern in the interior part of the globe, and an universal deluge would infallibly succeed. I should rather incline to think, that such a revolution would not be suddenly accomplished, but that it would require a very long period. However these conjectures stand, it is certain, that such a revolution has happened, and I even believe that it happened naturally; for, if a judgment of the future is to be formed from the past, we have only to attend carefully to what daily passes before our eyes. It is a fact, established by the repeated observation of voyagers, that the ocean has a constant motion from east to west. This motion, like the trade-winds, is not only perceived between the tropics, but through the whole temperate climates, and as near the poles as navigators have been able to approach. As a necessary consequence of this motion, the Pacific Ocean must make continual efforts against the coasts of Tartary, China, and India; the Indian Ocean must act against the east coast of Africa; and the Atlantic must act in a similar manner against all the eastern coasts of America. Hence the sea must have gained, and will always continue to gain, on the east, and to lose on the west. This circumstance alone would be sufficient to prove the possibility of the change of sea into land, and of land into sea. If such is the natural effect of the sea's motion from east to west, may it not be reasonably supposed, that Asia, and all the eastern continent, is the most ancient country in the world? and that Europe, and part of Africa, especially the west parts of these continents, as Britain, France, Spain, &c. are countries of a more recent date? Both history and physics concur in establishing this hypothesis.

But, besides the constant motion of the sea from east to west, other causes concur in producing the effect just mentioned. There are many lands lower than the level of the sea, and are defended by a narrow isthmus of rock only, or by banks of still weaker materials. The action of the waters must gradually destroy these barriers; and, consequently, such lands must then become part of the ocean. Besides, the mountains are daily diminishing, part of them being constantly carried down to the valleys by rains. It is likewise well known, that every little brook carries earth, and other matters, from the high grounds into the rivers, by which they are at last transported in the ocean. By these means, the bottom of the sea is gradually filling up, the surface of the earth is approaching to a level, and nothing but time is wanting for the sea's successively changing places with the land.

I speak not here of causes removed beyond the sphere of our knowledge, of those convulsions of nature, the slightest effort of which would be fatal to the globe. The near approach of a comet, the absence of the moon, or the introduction of a new planet into the system, &c. are suppositions upon which the imagination may rove at large. [Since the Count de Buffon composed

this work, the ingenious discoveries of Dr. Herschel and others have demonstrated that new planets have been, and may be, added to the solar system.] Causes of this kind will produce any effect we choose. From a single hypothesis of this nature, a thousand physical romances might be composed, and their authors might dignify them with the title of *Theory of the Earth.* As an historian, I reject these vain speculations; they depend upon mere possibilities, which, if called into action, necessarily imply such a devastation in the universe, that our globe, like a fugitive particle of matter, escapes observation, and is no longer worthy of our attention. But, to give consistency to our ideas, we must take the earth as it is, examine its different parts with minuteness, and, by induction, judge of the future, from what at present exists. We ought not to be affected by causes which seldom act, and whose action is always sudden and violent. These have no place in the ordinary course of nature. But operations uniformly repeated, motions which succeed one another without interruption, are the causes which alone ought to be the foundation of our reasonings.

Some examples shall be given: we shall combine particular effects with general causes, and give a detail of facts which will illustrate and explain the different alterations that the earth has undergone, whether by irruptions of the sea upon the land, or by the sea's retiring from lands which it formerly covered.

That irruption which gave rise to the Mediterranean (proofs, art. XI. and XIX.) is undoubtedly the greatest, (Ray's Discourses, p. 209; Plot. Hist. Nat. &c.) The ocean runs with prodigious rapidity through a narrow passage between two promontories, (Phil. Trans. abridged, vol. ii. p. 289.) and then forms a vast sea, which, exclusive of the Black Sea, is about seven times larger than the kingdom of France. The motion through the Straits of Gibraltar is contrary to the motion in every other strait. The general motion of the sea is from east to west; but, in the Straits of Gibraltar, it is from west to east; an incontestible proof, that the Mediterranean Sea is not an ancient gulf, but that it has been formed by an irruption, produced by some accidental cause, such as an earthquake swallowing up the barrier, or a violent effort of the ocean, occasioned by the wind, and forcing its way through the bank between the two promontories of Gibraltar and Ceuta. This opinion is supported by the testimony of the ancients, (Diodorus Siculus, Strabo,) who inform us, that there was a time when the Mediterranean had no existence. It is likewise confirmed by natural history, and by observations upon the strata on the opposite coasts of Africa and Spain, where, as in neighbouring mountains the beds of earth and stone are precisely the same at equal levels.

When the ocean forced this passage, it ran through the Straits with much more rapidity than at present, and instantly deluged that large tract of land which formerly joined Europe to Africa The waters covered all the grounds which were lower than the level of the ocean; and no part of them is now to be seen except the tops of some of the mountains, such as part of Italy, Sicily, Malta, Corsica, Sardinia, Cyprus, Rhodes, and the islands of the Archipelago.

I have not mentioned the Black Sea as an effect of this irruption; because the quantity of water it receives from the Danube, the Nieper, the Don, and other rivers, is more than sufficient both to form and support this sea. Besides, it runs with great rapidity through the Bosphorus into the Mediterranean, (Phil. Trans. abridged, vol. ii. p. 289.) It may even be supposed, that the Black and Caspian Seas were only two large lakes, which were perhaps joined by a narrow communication, or rather by a morass, or small lake, uniting the Don and the Wolga about Tria, where these two rivers run very near each other. It is likewise probable, that these two seas or lakes were formerly of a much greater extent! For the large rivers which fall into the Black and Caspian Seas, must have gradually brought down a quantity of earth and sand sufficient to stop up the communication, and to form that neck of land by which these two seas are divided. We know, that large rivers, in a course of time, block up seas, and form new lands, as in the province at the mouth of the Yellow River in China; Louisiana at the mouth of the Mississippi; and the northern part of Egypt, which derived its existence (Shaw's Travels,) from the inundations of the Nile, (proofs, art. XIX.) Such quantities of earth are brought down by the rapidity of the Nile, from the interior parts of Africa, and deposited during the inundations, that you may dig fifty feet before you can reach the bottom of the slime and mud. Louisiana, and the province of the Yellow River, have, in the same manner, been originally formed by the slime of rivers.

Farther, the Caspian Sea is a real lake. It has no communication with any other sea, not even with the Lake Aral, which appears to have been a part of it, being only separated by a large tract of sand, in which neither river nor canal for carrying off the waters have been discovered. This sea, therefore, has no external communication with any other; and I doubt much if there is any reason to suspect a subterraneous communication with the Black Sea, or with the gulf of Persia. The Caspian, it is true, receives the Wolga, and several other rivers, which appear to furnish as much water as is lost by evaporation. But, independent of the difficulties attending such calculations, if it communicates with any other sea, a uniform and rapid current towards the place of communication would be an infallible consequence; but nothing of this kind has yet been discovered. Travellers

of the best credit assure us of the contrary. We, therefore, conclude, that the Caspian Sea receives just as much water from the rivers and clouds as it loses by evaporation.

It is not improbable, that the Black Sea will, in time, be entirely divided from the Mediterranean; and that the Bosphorus will be choaked up, whenever the rivers shall have accumulated a sufficient quantity of materials to bring about that effect. It is impossible to fix the æra of this event; but time, and the diminution of waters in rivers, in proportion as the mountains are lowered by the causes mentioned above, will one day exhibit this phenomenon to the world.

The Caspian and Black Seas should, therefore, be considered rather as lakes than as gulfs of the ocean; because they exactly resemble other lakes which receive a number of rivers without any visible outlet, as the Dead Sea, several lakes in Africa, and elsewhere. Besides, the saltness of these two seas is not nearly equal to that of the Mediterranean or of the ocean; and, it is an agreed point, that the navigation in the Caspian and Black Seas, on account of their numberless shoals, rocks, and banks, is so extremely hazardous, that small vessels only can be used in them with safety. This circumstance farther proves, that these seas ought not to be considered as gulfs of the ocean, but as vast collections of water amassed by large rivers.

If the isthmus which separates Africa from Asia were cut, it would necessarily create a great irruption of the sea upon the land. This junction was formerly projected by the kings of Egypt, and adopted since by the Califs. I doubt whether the pretended communication between the Red Sea and Mediterranean be sufficiently established. The Red Sea is a narrow branch of the ocean: through its whole extent, not a single river runs into it from the Egyptian side, and very few from the opposite. This sea will not, therefore, be subject to diminution, like those seas or lakes which are actually impaired by the slime and sand brought down by large rivers. The Red Sea receives all its waters directly from the ocean, and the motion of the tides in it are very discernible; of course, it must be affected by the general motions of the ocean. The Mediterranean, on the other hand, must be lower than the ocean; because the current through the Straits is exceedingly rapid. Besides, it receives the Nile, which runs parallel to the west coast of the Red Sea, and passes through the longest extent of Egypt, which is a very low country. From these circumstances, it is at least probable, that the Red Sea is higher than the Mediterranean, and, consequently, that if the isthmus of Suez were cut, a great inundation, and a considerable augmentation of the Mediterranean, would ensue; especially if the waters were not restrained by dikes and sluices, placed at proper distances. This precaution was probably used, if ever the ancient canal existed.

But, not to spend time on conjectures, which, however well founded, may perhaps appear rash, we shall give some certain and recent examples of the changes of sea into land, and of land into sea, (proofs, art. XIX.) At Venice, the bottom of the sea is constantly rising: if the canals had not been carefully kept clean, the moats and city would, long ere now, have formed a part of the continent. The same thing may be said of most harbours, bays, and mouths of rivers. In Holland, the bottom of the sea is elevated in many places; the gulf of Zuderzee and the straits of the Texel, cannot receive such large vessels as formerly. At the mouth of almost every river, we find small islands, and banks of earth and sand brought down from the higher grounds; and it is incontrovertible, that the sea is constantly dammed up, wherever great rivers empty themselves. The Rhine is lost in the sands which itself has accumulated. The Danube, the Nile, and all large rivers, after having transported great quantities of slime, sand, &c. never more arrive at the sea by a single channel; they split into branches, the intervals of which consist of the materials which they themselves have transported. Marshes are daily drained; lands, abandoned by the sea, are now plowed and sown; we navigate whole countries now covered by the waters; in a word, we see so many instances of land changed into water, and water into land, that we must be convinced of the continual, though slow progress of such changes in all places. Hence the gulfs of the ocean will in time become continents; the isthmuses will be changed into straits; and the tops of the mountains will be metamorphosed into shoaly rocks in the sea.

The waters, therefore, have covered, and may still cover, every part of the earth which is now dry. Hence our astonishment at finding the productions of the sea dispersed every where, and a composition of bodies which could not be effected by any other means than the operation of the waters, ought for ever to cease. We have already explained how the horizontal strata of the earth were formed. But those perpendicular fissures, which are equally diffused through rocks, clays, and every constituent material of the globe remain to be considered. The perpendicular fissures are indeed placed at greater distances from each other than the horizontal; and the softer the matter, the more distant are the fissures. In marble and hard stone, the perpendicular fissures are only a few feet asunder. If the mass of rock be extensive, the distance between the fissures is some fathoms: sometimes they extend from the summit to the base of the rock, and sometimes they terminate after arriving at a horizontal fissure. They are uniformly perpendicular in the strata of all calcareous substances, as chalk, marls, marble, &c. But they are more oblique, and less regularly situated, in vitrescent bodies, brown free-stone, and rocks of flint, where they are often adorned with crystals and other minerals. In quarries

of marble, or of calcareous stone, the fissures are filled with spar, gypsum, gravel, and an earthy sand, which contains a considerable portion of chalk. In marls, and every other species of earth, except sand-stone, the perpendicular fissures are either empty, or filled with such matters as have been transported thither by the water.

The cause of perpendicular fissures is easily investigated. As the various materials which constitute the different strata were transported by the waters, and deposited in the form of sediments, they would at first be in a very diluted state, and would gradually harden and part with the superfluous quantity of water they contained. In the process of drying, they would naturally contract, and of course split at irregular distances. These fissures necessarily assumed a perpendicular direction; because, in this direction, the action of gravity of one particle upon another is equal to nothing; but it acts directly opposite in an horizontal situation. The diminution in bulk could have no sensible effect but in a vertical line. I say, the contraction of the parts in drying, not the contained water forcing an issue, as has been alleged, is the cause of perpendicular fissures; for I have often remarked, that the sides of these fissures, through their whole extent, correspond as exactly as the two sides of a split piece of wood. Their surfaces are rude and irregular. But, if they had taken their rise from the motion of the water, they would have been smooth and polished. Hence these fissures must have been produced, either suddenly or gradually, by drying and contracting, like the cracks and fissures in green wood; and the greatest part of the water the bodies contained must have evaporated through the pores. In the chapter upon minerals, we shall demonstrate, that some part of the original water still remains in stones and several other substances; and that crystals, minerals, and some other bodies, owe their existence to this water.

Perpendicular fissures vary greatly as to the extent of their openings. Some are about half an inch, or an inch, others a foot, or two feet; some extend several fathoms, and give rise to those vast precipices which so frequently occur between opposite parts of the same rocks in the Alps and other high mountains. It is plain, that the fissures, the openings of which are small, have been occasioned solely by drying. But those which extend several feet are partly owing to another cause; namely, the sinking of the foundation upon one side, while that of the other remained firm. If the base sinks but a line or two, when the height of the rock is considerable, an opening of several feet, or even fathoms, will be the consequence. When rocks are founded on clay or sand, they sometimes slip a little to a side; and the fissures are of course augmented by this motion. I have not hitherto mentioned those large openings, those prodigious cuts, which are to be met with in rocks and mountains: these could not be produced by any other means than the sinking of immense subterraneous caverns which were unable longer to sustain their incumbent load. But these cuts or intervals in mountains are not of the same nature with perpendicular fissures: they appear to have been ports opened by the hand of nature for the communication of nations. This seems to be the intention of all large openings in chains of mountains, and of those straits by which different parts of the ocean are connected; as the Straits of Thermopylæ, of Gibraltar, &c. the gaps or ports in Mount Caucasus, the Cordeliers, &c. A simple separation, by the drying of the matter, could not produce this effect: large portions of earth must have been sunk, swallowed up, or thrown down, (proofs, art. XVII.)

These great sinkings, though occasioned by accidental and secondary causes, (proofs, art. XVII.) are leading facts in the history of the earth, and have contributed greatly in changing the appearance of its surface. Most of them have been produced by subterraneous fires, the explosions of which give rise to earthquakes and volcanos. The force of inflamed matter, shut up in the bowels of the earth, is irresistible, (Agricola de Rebus quæ effluunt è Terra. Phil. Trans. abrid. vol. ii. p. 391. Ray's discourses, p. 272.) By the action of subterraneous fires, whole cities have been swallowed up, mountains, and large tracts of country, have been overturned and rendered unfit for the habitation of men. But, though this force be great, though its effects appear to be prodigious, we cannot assent to the opinions of some authors, who suppose that these subterraneous fires are only branches of an immense abyss of flame in the centre of the earth. Neither do we credit the common notion, that these fires have their seat at a great depth below the surface; for matter cannot begin to burn, or at least the inflammation cannot be supported without air. In examining the materials which issue from volcanos, even in the most violent eruptions, it is easy to perceive that the furnace is not very deep, and that the inflamed substances are the same with those on the top of the mountain, only disfigured by calcination and the melting of the metallic particles they contain. To be convinced that the matters thrown out by volcanos come not from any considerable depth, we need only attend to the height of the mountain, and consider the immense force which would be necessary to project stones and minerals to the height of half a league; for Ætna, Hecla, and other volcanos, have at least that elevation.

Now, it is well known, that fire acts equally on all sides; it cannot, therefore, act upwards with a force sufficient to throw large stones half a league high, without an equal re-action on the base and sides. But the sides of the mountain would very soon be pierced and blown to pieces by this re-action; because the materials of which it consists are not more dense or firm than

those which are projected. How, then, can it be imagined, that the cavity, which must be considered as the tube or cannon, could possibly resist a force necessary to raise such heavy bodies to the mouth of the volcano? Besides, suppose the cavity deeper, as the external orifice is not great, it would be impossible for so large a quantity of liquid and burning matters to issue forth at a time, without clashing against each other, and against the irregular sides of the cavity; and, in passing through so long a space, they would be in danger of cooling and congealing. Rivers of melted sulphur and bitumen, projected from volcanos along with stones and minerals, run from the tops of the mountains into the plains. Is it natural to think, that matter so fluid, so little able to resist violent action, could be projected from a very great depth? Every observation which can be made on this subject will tend to prove, that the fire in volcanos is not very distant from the tops of the mountains, and never descends so low as the level of the plains, (Borelli de incendiis Ætnæ.)

This account of volcanos, however, is not inconsistent with their being the cause of considerable earthquakes; neither does it contradict the communication of one volcano with another, by means of subterraneous passages, (Phil. Trans. abridged, vol. ii. p. 392.) But the depth of the furnace is the object of our present investigation, and it cannot be very distant from the mouth of the volcano. To produce an earthquake in a plain, it is not necessary that the bottom of the volcano should be below the level of that plain, nor that there should be subterraneous cavities filled with the same burning matter under the plain. A violent explosion, with which eruptions are uniformly accompanied, may, like that of a powder magazine, give such a concussion as to produce, by its re-action, an earthquake of considerable extent.

I mean not to say that there are no earthquakes which derive their existence from subterraneous fires, (proofs, art. XVI.) but that there are earthquakes produced solely by the explosion of volcanos. In confirmation of what has been said upon this subject, volcanos seldom or never appear in plains; on the contrary, their mouths, or craters, are always found on the tops of the highest mountains. If the subterraneous fire of volcanos stretched below the plains, would not new passages be opened there during violent eruptions, rather than in the tops of the mountains, where the resistance is greater? In the first eruption, would it not have been easier to pierce a plain, than a mountain of half a league in height?

It is not difficult to discover the reason why volcanos appear only in mountains. Greater quantities of minerals, sulphur, and pyrites, exist in mountains, and nearer the surface, than in plains. The mountains have likewise this farther advantage; they are more subject to the impressions of the air, and receive more rain and moisture, by which mineral substances are capable of being fermented to such a degree as to produce actual inflammation.

To conclude, it has often been observed, that, after violent eruptions, the mountains have sunk and diminished, nearly in proportion to the quantity of matter thrown out, which is another proof that volcanos are not so deep as the base of the mountains, and even that they are not much below the summit.

In many places, earthquakes have formed considerable hollows, and even some large gaps, in mountains. All other inequalities are coeval with the mountains themselves, and owe their existence to currents in the ocean; for, in every place which has not been disturbed by accidental convulsions, the strata of mountains are parallel, and their angles correspond, (proofs, art. XVII.) It is not difficult to distinguish subterraneous caverns and excavations formed by volcanos, from those produced by water. The latter consist only of solid rocks, the sand and clay with which they were formerly filled being carried off by the water, which is the origin of caverns in hills; for those found in plains are commonly nothing but old pits and quarries, like the salt quarries of Maestricht, the mines of Poland, &c. But natural caverns are proper to the mountains; the summit, or higher parts, furnish them with water, which afterwards issues out to the surface wherever it can find a passage. These caverns are the sources of springs and rivers. When a large cavern of this kind is suddenly filled up by the falling of its roof, an inundation is generally the consequence, (Phil. Trans. abridged, vol. ii. p. 322.)

From these facts, it is easy to perceive how much subterraneous fires have contributed to change both the surface and internal part of the globe. This cause has power sufficient to produce very great effects. But it is difficult to conceive how any sensible alterations upon the land can be introduced by the winds, (proofs, art. XV.) Their dominion would appear to be confined to the sea. Indeed, next to the tides, nothing has such a powerful influence upon the waters; the flux and reflux proceed with an uniform pace; their operations are always the same; but the action of the winds is capricious and violent. They rush on with irresistible fury, and excite such impetuous commotions, that the ocean, from a smooth and tranquil plain, in an instant is furrowed with waves which emulate the height of mountains, and dash themselves in pieces against the shores. The surface of the ocean is subject to constant alterations from the winds. But ought not the surface of the land, which has so solid an appearance, ever to remain uninfluenced by a cause of this kind? It is consonant to experience, however, that the winds raise mountains of sand in Arabia and Africa; that they overwhelm large plains with it; and that they frequently carry these sands many leagues into the sea, where they accumulate in such quantities as to form banks, downs, and even islands,

(Bellarmin. de ascen. mentis in Deum. Varen. Geog. p. 282. Voyag. de Pyrard, tom. i. p. 470.) It is also well known, that hurricanes are the scourge of the Antilles, of Madagascar, and of other countries, where their impetuosity is so great, that they sweep away trees, plants, and animals, together with the soil which nourished them. They drive back, they annihilate rivers, and produce new ones; they overthrow rocks and mountains; they scoop out holes and gulfs in the earth, and totally change the face of those unhappy countries which give birth to them. Happily, few climates are exposed to the violence of those dreadful agitations of the air.

But the greatest changes upon the surface of the earth are occasioned by rains, rivers, and torrents from the mountains. These derive their origin from vapours raised by the sun from the surface of the ocean, and are transported by the winds through every climate. The progress of these vapours, which are supported by the air, and transported at the pleasure of the winds, is interrupted by the tops of the mountains, where they accumulate into clouds, and fall down in the form of rain, dew, or snow. At first, these waters descended into the plains without any fixed course; (see proofs, art. X. and XVIII.) but they gradually hollowed out proper channels for themselves. By the power of gravity, they ran to the bottom of the mountains, and, penetrating or dissolving the lower grounds, they carried along with them sand and gravel, cut deep furrows in the plains, and thus opened passages to the sea, which always receives as much water by rivers as it loses by evaporation. The windings in the channels of rivers have uniformly corresponding angles on their opposite banks; and as mountains and hills, which may be regarded as the banks of the valleys by which they are separated, have likewise sinuosities with corresponding angles, this circumstance seems to demonstrate, that the valleys have been gradually formed by currents of the ocean, in the same manner as the channels of rivers have been produced.

The waters which run upon the surface, and support the verdure and fertility of the soil, compose not perhaps one half of the quantity that is produced by vapour. Numberless veins of water sink deep into the bowels of the earth. In some places, you are certain of obtaining water by digging; in others, none can be found. In almost all the valleys and low grounds, at a certain depth, water is uniformly to be met with. But, in all high grounds, it is impossible to extract water from the bowels of the earth. It must be collected from the heavens. There are extensive countries where no wells can be obtained: there men and other animals are supplied with drink from cisterns and pools. In the east, and especially in Arabia, Egypt, and Persia, wells and springs are great and valuable rarities. To supply their place, the inhabitants have been obliged to make large reservoirs, to collect the water that falls from the heavens. These works, projected and executed from public necessity, constitute the most beautiful and magnificent monuments of the east. Some eastern reservoirs have more than two square leagues of superficies, and fertilize whole provinces by numberless ducts and canals let out from all sides. But, in plain countries, furnished with large rivers, it is impossible to break the surface of the earth without finding water. In camps situated in the neighbourhood of rivers, it often happens, that every tent may have its own well, by giving a few strokes with a pick-ax.

Most of the water, so liberally diffused through low grounds, comes from the neighbouring hills and eminences. During great rains, or the sudden melting of snow, part of the water runs upon the surface; but most of it penetrates the earth and rocks, by means of small chinks and fissures. This water rises again to the surface, whenever it can find an issue; but it often drills through sands, and creeps along till it finds a bottom of clay, or hard earth, and there forms subterraneous lakes, brooks, and perhaps rivers, of which the channels are for ever buried in oblivion. Subterraneous rivers, however, must follow the general law of nature, and uniformly run from the higher to the lower ground. Their waters must of course either fall at last into the sea, or be collected in some low place, whether at the surface, or in the bowels of the earth: for there are several lakes which neither receive nor give rise to any river. A still greater number receive no considerable river, but are the sources of the largest rivers on earth; as the lakes from which the river St. Laurence issues; the lake Chiamé, from which two large rivers arise, that water the kingdoms of Asem and Pegu; the lakes of Assiniboil in America; those of Ozera in Muscovy; those that give rise to the Bog and the Irtis, and many others, (proofs, art. XI.) It is plain, that these lakes must derive their existence from the waters of superior grounds, running through subterraneous passages. Some, indeed, have affirmed, that lakes are to be met with on the tops of the highest mountains. But this is incredible; for the lakes found on the Alps, and other elevated situations, are all overtopped by higher mountains, and derive their origin from the waters which run down the sides, or are filtered through the bowels of these superior eminences, in the same manner as the lakes in valleys are supplied.

From this reasoning, the existence of subterraneous collections of water, especially under large plains, is apparent; (proofs, art. XVIII.) for mountains, hills, and heights of every kind, are exposed on all sides to the weather. The waters which fall upon their summits, and upon elevated plains, after penetrating the earth, must, from the declivity of the ground, break out at

many places in the form of springs and fountains: of course little water will be found in the bowels of mountains. But, in plains, as the water filtrated through the earth can find no issue, it must be collected in subterraneous caverns, or dispersed in small veins, among sand and gravel. This is the origin of the water so universally diffused through low grounds. The bottom of a pit or well is only a small artificial bason, into which the water insinuates itself from the higher grounds. At first it generally falls in by drops; but afterwards, when the passages become more open, it receives fresh supplies from greater distances, and runs in small continued veins or rills. To this circumstance it is owing, that, although water may be found in any part of a plain, only a certain number of wells can be supplied. This number is in proportion to the quantity of water diffused, or rather to the extent of the high grounds from which it comes.

To find water, it is unnecessary to dig below the level of a river. It is commonly found at smaller depths. The water of rivers seldom spreads far in the earth by filtration. Even what is found in the earth, below the level of the rivers, is not derived from them; for, in rivers which have been dried up, or whose courses have been changed, no greater quantity of water is obtained by digging, than in the neighbouring ground at an equal depth. Five or six feet of earth is sufficient to contain water, and to prevent its escape: I have often remarked, that the banks of rivulets or pools have no sensible moisture at the distance of six inches from the water. It is true, the filtration is always in proportion to the penetrability of the ground. But, upon examining the stagnating pools with a sandy bottom, it is remarkable that the moisture spreads but a few inches. Neither is the extent of it great in a vegetable soil, which is much more loose and porous than sand or hard earth. A garden-bed, though plentifully watered, communicates little or no moisture to those adjoining. I have examined level heaps of garden-earth, of six or eight feet thick, which had remained undisturbed for some years, and found that the rain-water had never reached above three or four feet deep. I have made the same observation upon earth which had lain 200 years in ridges: below the depth of three or four feet it was as dry as dust. Hence the spreading of water, by filtration alone, is not so extensive as has generally been imagined. Very little can descend in this way to the bowels of the earth. But water, by its own gravity, descends from the surface to the greatest depths. It sinks through natural conduits, or forces passages for itself: it follows the roots of trees, the fissures of rocks, or interstices in the earth. It divides and expands on all hands into an infinite number of small branches or rills; and uniformly descends till its progress is stopped by clay or a solid earth where it accumulates and breaks out to the surface in form of a spring or fountain.

It would be no easy task to make an exact calculation of the quantity of subterraneous waters which have no apparent issue, (proofs, art. X. XI. and XVIII.) Many authors pretend that it greatly surpasses all the waters on the surface: not to mention those who think that the interior part of the globe is entirely filled with water, it is imagined by some, that there is an infinite number of rivers, rills, and lakes, in the bowels of the earth. But this opinion seems to have no proper foundation; and, it is probable, that the quantity of subterraneous waters, which never appear at the surface, is very inconsiderable; for, if the number of subterraneous rivers were so great, why do we never see any of their mouths break out, like springs, on the surface. Besides, rivers produce considerable changes on the surface of the earth; they carry off the soil; they wear away the most solid rocks, and remove every thing that opposes their passage. The same effects would result from subterraneous rivers. But no such changes have ever been discovered; nothing below the surface is displaced; the different strata every where preserve their parallel and primitive position; and it is only in very few places that subterraneous veins of water, of any consideration have been discovered. Thus, the internal operation of water is not great; but, as it is divided into an infinity of small veins, which are often shut up by numberless obstacles, it gives rise to many substances, which are totally different, both in form and structure, from those of the primitive matter.

From what has been advanced, we may conclude, that the flux and reflux of the ocean have produced all the mountains, valleys, and other inequalities on the surface of the earth; that currents of the sea have scooped out the valleys, elevated the hills, and bestowed on them their corresponding directions; that the same waters of the ocean, by transporting and depositing earth, &c. have given rise to the parallel strata; that the waters from the heavens gradually destroy the effects of the sea, by continually diminishing the height of the mountains, filling up the valleys, and choaking the mouths of rivers; and, by reducing every thing to its former level, they will, in time, restore the earth to the sea, which, by its natural operations, will again create new continents, interspersed with mountains and valleys, every way similar to those which we now inhabit.

PROOFS OF THE THEORY OF THE EARTH

ARTICLE I.

Of the Formation of Planets.

As natural history is our proper subject, we would willingly dispense with astronomical observations. But, as the earth is so nearly related to the heavenly bodies, and, as observations of this kind illustrate more fully those doctrines we have already advanced, it is necessary to give some general ideas concerning the formation, motion, and figure of the earth, and other planets.

The earth is a globe of about 3000 leagues in diameter; it is situated 30 millions of leagues from the sun, round which it revolves in 365 days. This annual revolution is the effect of two forces; the one may be considered as an impulse from right to left, or from left to right; the other as an attraction from above downwards, or from below upwards, to a common centre. The direction and quantity of these forces are combined, and so nicely adjusted, that they produce an uniform motion in an ellipse approaching to a circle. Like the other planets, the earth is opaque, throws out a shadow, and reflects the rays of the sun, about which it revolves in a time proportioned to its relative distance and density. It likewise revolves about its own axis in 24 hours; and its axis is inclined to the plane of its orbit $66\frac{1}{2}$ degrees. Its figure is that of a spheroid, the two axes of which differ from each other about an 165th part; and it revolves round the shortest axis.

These are the principal phænomena of the earth, the results of discoveries made by means of geometry, astronomy, and navigation. It is unnecessary here to enumerate the proofs and observations by which these facts have been established. We shall confine our remarks to such objects as are still doubtful; and shall therefore proceed to give our ideas concerning the formation of planets, and the changes they have undergone, previous to their arriving at the state in which we now perceive them. To the many systems and hypotheses which have been framed concerning the formation of the earth, and the different states it has passed through, we may be allowed to add our own conjectures, especially as we are determined to support them with a superior degree of probability; and we are the more encouraged to deliver our notions on this subject, because we hope to enable the reader to distinguish between an hypothesis which consists only of possibilities, and a theory supported by facts; between a system, such as we are about to give, of the formation and primitive state of the earth, and a physical history of its real condition, which has been delivered in the preceding discourse.

Galileo traced the laws of falling bodies; and Kepler observed, that the areas which the principal planets describe in moving round the sun, and those of the satellites round their principal planets, were proportioned to the periods of their revolutions, and that these periods were as the square roots of the cubes of their distances from the sun, or from the principal planets. Newton discovered that the power of gravity extended to the moon, and retained it in its orbit; that the force of gravity diminished in exact proportion to the squares of the distances, and, consequently, that the moon is attracted by the earth; that the earth, and all planets, are attracted by the sun; and, in general, that all bodies which revolve about a centre, and describe areas proportioned to the periods of their revolution, are attracted by that luminary. Gravity, therefore, is a general law of nature. The planets, comets, the sun, the earth, are all subject to its laws; and it is the source of that harmony which prevails in the universe. Nothing in physics is better established than the existence of this power in every material body. Repeated experience has confirmed the effects of its influence, and the labour and ingenuity of geometers have determined its quantity and relations.

This general law being once discovered, the effects of it would be easily explained, if the action of those bodies which produce them were not too complicated. A slight view of the solar system will convince us of the difficulties which attend this subject. The principal planets are attracted by the sun, the sun by the planets, the satellites by the principal planets, and each planet attracts all the others, and is attracted by them. All these actions and re-actions vary according to the quantities of matter and the distances, and give rise to great inequalities, and even irregularities. How are so many relations to be combined and estimated? Among such a number of objects, how is it possible to trace any individual? These difficulties, however, have been surmounted; the reasonings of theory have been confirmed by calculation; every observation has produced a new demonstration; and the systematic order of the universe is now laid open to every man who is able to distinguish truth from error.

The force of impulsion, or what is commonly called the centrifugal force, is still unknown; but it affects not the general theory. It is evident, that, as the attractive force continually draws all the planets towards the sun, they would fall in a perpendicular line into that luminary, if they were not kept at a distance by some other power, forcing them to move in a straight line. If, again, this impulsive force were not counteracted by that of attraction, all the planets would fly off in the tangents of their respective orbits. This progressive or impulsive force was unquestionably at first communicated to the planets by the Supreme Being. But, in physical subjects, we ought, as much as possible, to avoid having recourse to supernatural causes; and, I imagine, a probable reason may be assigned for the impulsive force of the planets, which will be agreeable to the laws of mechanics, and not more surprising than many revolutions that must have happened in the universe.

The sphere of the sun's attraction is not limited by the orbits of the planets, but extends to an indefinite distance, always decreasing according as the squares of the augmented distances. The comets, it is evident, which escape our sight in the heavenly regions, are, like the planets, subject to the attraction of the sun, and by it their motions are regulated. All these bodies, the directions of which are so various, move round the sun, and describe areas proportioned to their periods, the planets in ellipses, more or less circular, and the comets, in narrow ellipses of vast extent. The motions, therefore, both of planets and comets, are regulated by impulsive and attractive forces continually acting upon them, and obliging them to describe curves. But it is worthy of remark, that comets run through the system in all directions; that the inclinations of the planes of their orbits are so very different, that though, like the planets, they be subject to the law of attraction, they have nothing in common with regard to their progressive or impulsive motions, but appear, in this respect, to be absolutely independent of each other. The planets, on the contrary, move round the sun in the same direction, and nearly in the same plane, the greatest inclination of their planes not exceeding $7\frac{1}{2}$ degrees. This similarity in the position and motion of the planets indicates, that their impulsive or centrifugal forces must have originated from one common cause.

May we not conjecture, that a comet falling into the body of the sun might drive off some parts from its surface, and communicate to them a violent impulsive force which they still retain? This conjecture appears to be as well founded as that of Mr. Leibnitz, which supposed the earth and planets to have been formerly suns; and his system, of which an abridgment will be given in Art. V. would have been more comprehensive, and more consonant to probability, if it had embraced the above idea. We agree with him, that this effect was produced at the time when God is said by Moses to have separated the light from the darkness; for, according to Leibnitz, the light was separated from the darkness when the planets were extinguished. But, on our supposition, there was a real physical separation; because the opaque bodies of the planets were detached from the luminous matter of which the sun is composed. [If the Count de Buffon had known, that the nucleus of the sun was a solid and opaque matter, a discovery lately made by the ingenious Dr. Wilson, of Glasgow, his hypothesis would have laboured under fewer difficulties.]

This notion concerning the cause of the centrifugal force of the planets will appear to be less exceptionable, after we have collected the analogies, and estimated the degrees of probability by which it may be supported. We shall first mention, that the motion of the planets have one common direction, namely, from west to east. By the doctrine of chances, it is easy to demonstrate, that this circumstance makes it as 64 to 1, that the planets could not all move in the same direction, if their centrifugal forces had not proceeded from the same cause.

This probability will be greatly augmented, if we consider the similarity in the inclinations of the planes of their orbits, which exceed not $7\frac{1}{2}$ degrees; for, by calculations, it has been discovered, that it is 24 to 1 against any two planets being found, at the same time, in the most distant parts of their orbits; and, consequently, 24^5, or 7692624 to 1, that this effect could not be produced by accident; or, what amounts to the same, there is this great degree of probability, that the planets have been impressed with one common moving force, from which they have derived this singular position. But nothing could bestow this common centrifugal motion, except the force and direction of the bodies by which it was originally communicated. We may, therefore, conclude, that all the planets have probably received their centrifugal motion by one single stroke. Having established this degree of probability, which almost amounts to a certainty, I next inquire what moving bodies could produce this effect; and I can find nothing but comets capable of communicating motion to such vast masses.

Upon examining the course of comets, it is easy to believe that some of them must occasionally fall into the sun. The comet of 1680 approached so near, that, at its perihelion, it was not more distant from the sun than a sixteenth part of his diameter; and, if it returns, which is extremely probable, in the year 2255, it may then fall into the sun. This event must depend upon the accidents it meets with in its course, and the retardations it suffers in passing through the sun's atmosphere, (see Newt. edit. 3. p. 525.)

We may, therefore, presume, with the great Newton, that comets sometimes fall into the sun. But they may

fall in different directions. If they fall perpendicularly, or in a direction not very oblique, they will remain in the body of the sun, serve the purposes of fuel, and, by their impulse, remove the sun from his place, in proportion to the quantity of matter they contain. [*Quær.* Would not such an event, by augmenting the sun's quantity of matter, and, consequently, his attractive power, produce other changes in the solar system?] But, if a comet falls in a very oblique direction, which will most frequently happen, it will only graze the surface, or penetrate to no great depth. In this case, it may force its way past the sun, detach certain portions of his body, to which it will communicate a common impulsive motion; and these portions pushed off from the sun, and even the comet itself, may turn planets, which will revolve round this luminary in the same direction, and nearly in the same plane. A calculation, perhaps, might be made of the quantity of matter, velocity, and direction, a comet ought to have, in order to force from the sun masses equal to those which compose the six planets and their satellites. But it is sufficient here to observe, that the whole planets, with their satellites, make not a 650th part of the sun's mass; (see Newt. p. 405.) for although the density of Saturn and Jupiter be less than that of the sun, and though the earth be four times, and the moon nearly five times more dense than the sun; yet they are only atoms when compared to his immense volume. It must be acknowledged, that, although a 650th part of a whole may seem inconsiderable, it would require a very large comet to detach this part from the sun. But, if we consider the prodigious rapidity of comets in their perihelion; the near approach they make to the sun; the density and strong cohesion of parts necessary to sustain, without destruction, the inconceivable heat they undergo; and the solid and brilliant nucleus which shines through their dark atmospheres; it cannot be doubted that comets are composed of matters extremely dense and solid; that they contain, in small limits, a great quantity of matter; and, consequently, that a comet of no enormous size may remove the sun from his place, and give a projectile motion to a mass of matter equal to the 650th part of his body. This remark corresponds with what we know concerning the respective densities of the planets, which always decrease in proportion to their distances from the sun, having less force of heat to resist. Accordingly, Saturn is less dense than Jupiter, and Jupiter much less than the earth. Thus, if the density of the planets, as Newton alleges, be in proportion to the quantity of heat they support, Mercury will be seven times denser than the earth, and 28 times denser than the sun, and the comet of 1680, 28,000 times more dense than the earth, or 112,000 times denser than the sun. Now, supposing the quantity of matter in this comet to be equal to a ninth part of the sun, or, allowing it to be only the 100th part of the bulk of the earth, its quantity of matter would still be equal to a 900th part of the sun: Hence a body of this kind, which would be but a small comet, might push off from the sun a 900th or a 650th part, especially when the amazing rapidity of comets, in their perihelion, is taken into the calculation.

The correspondence between the density of the whole planets, and that of the sun, deserves also to be noticed. Upon, and near the surface of the earth, there are substances 1400 or 1500 times denser than others; the densities of air and gold are nearly in this proportion. But the interior parts of the earth and planets are more uniform, and differ little with regard to density; and the correspondence in the density of the planets and that of the sun is so great, that, out of 650 parts, which comprehend the whole density of the planets, there are more than 640 nearly of the same density with the solar matter; and there are only ten of those 650 which are of a superior density; for the density of Saturn and Jupiter is nearly the same with that of the sun; and the quantity of matter in those two planets is at least 64 times greater than what is contained in the four inferior planets, Mars, the Earth, Venus, and Mercury. We may therefore conclude, that, in general, the matter of the planets is very nearly of the same kind with the solar matter, and, of course, that the former may have been separated from the latter.

To this theory, it may be objected, that, if the planets had been driven off from the sun, by a comet, in place of describing circles round him, they must, according to the law of projectiles, have returned to the same place from whence they had been forced; and therefore, that the projectile force of the planets cannot be attributed to the impulse of a comet.

I reply, that the planets issued not from the sun in the form of globes, but in the form of torrents, the motion of whose anterior particles must have been accelerated by those behind, and the attraction of the anterior particles would also accelerate the motion of the posterior; and that this acceleration, produced by one or both of these causes, might be such as would necessarily change the original motion arising from the impulse of the comet, and that, from this cause, might result a motion similar to what takes place in the planets, especially when it is considered, that the shock of the comet removes the sun out of its former station. This reasoning may be illustrated by an example. Suppose a musket-ball discharged from the top of a mountain, and that the force of the powder was sufficient to push it beyond a semidiameter of the earth, it is certain that this ball would revolve round the earth, and return at every revolution to the place from whence it had been discharged.

But, instead of a musket-ball, if a rocket were employed, the continued action of the fire would greatly accelerate the original impulsive motion. This rocket would by no means return to the same point like the ball; but, *cæteris paribus*, would describe an orbit, the perigee of which would be more or less distant from the earth in proportion to the greatness of the change produced in its direction by the accelerating force of the fire. In the same manner, if the original projectile force impressed by the comet on the torrent of solar matter were accelerated, it is probable, that the planets formed by this torrent acquired their present circular or elliptical movements round the sun.

The appearances exhibited in great eruptions from volcanos may give some idea of this acceleration of motion. When Vesuvius begins to groan and throw out inflamed matter, it has been often remarked, that the motion of the cloud first ejected is slower than the succeeding ones, and that they go on increasing in celerity, till at last the sulphur, lava, melted metal, and huge stones are thrown up; and that, though these observe nearly the same direction, they alter considerably that of the first cloud, and elevate it to a greater height than it would otherwise have reached.

The objection will be still farther obviated, if it be considered, that the impulse of the comet must, in some degree, have communicated a motion to the sun, and removed it from its former situation, and that, although this motion may now be so small as to escape the notice of astronomers, it may still, however, exist, and make the sun describe a curve round the centre of gravity of the system. If this be allowed, as I presume it will, the planets, instead of returning to the sun's body, would describe orbits, the perihelions of which would be as distant from the sun as the space that he presently occupies is distant from his original station.

It may be farther objected, that, if motion be accelerated in the same direction, no change in the perihelion could take place. But, is it credible, that no change of direction can happen in a torrent whose particles succeed each other? On the contrary, it is extremely probable, that a change was actually produced sufficient to make the planets move in their present orbits.

It may still be objected, that, if the situation of the sun had been changed by the shock of a comet, it would move uniformly: and, of course, this motion being common to the whole system, no alteration would be effected. But, previous to the shock, might not the sun move round the centre of the cometary system; and might not this primary motion be augmented or diminished by the stroke of the comet? Is not this sufficient to account for the actual motion of the planets?

If none of these suppositions be admitted, may it not be presumed, that the elasticity of the sun might elevate the torrent above his surface, in place of pushing it directly forward? This circumstance alone would be sufficient to remove the perihelion, and endow the planets with their present movements. Neither is this supposition destitute of foundation. The solar matter may be exceedingly elastic; since light, the only part of it we are acquainted with, seems, by its effects, to be perfectly elastic. I acknowledge that I cannot determine which of the causes above assigned has actually produced an alteration in the projectile force of the planets; but they at least show that such a change is not only possible, but probable, which is enough for my present purpose.

Without farther insisting on the objection which may be made against my hypothesis, or the analogical proofs that might be brought in support of it, I shall prosecute my subject, and draw the proper conclusions. Let us first examine what might happen to the planets, and particularly to the earth, when they were impressed with their projectile forces, and what was their state after their separation from the body of the sun. A projectile motion having been communicated, by the stroke of a comet, to a quantity of matter equal to a 650th part of the sun's mass, the light particles would separate from the dense, and, by their mutual attractions, form globes of different solidities. Saturn, being composed of the largest and lightest parts, would be removed to the greatest distance from the sun; Jupiter, being denser than Saturn, would have a nearer station; and so of the rest. The largest and least solid planets are most distant, because they received a greater projectile force than the smaller and denser; for the projectile force being proportioned to the surface to which it is applied, the same stroke would make the larger and lighter parts of the solar matter move with more rapidity than the smaller and heavier. The parts, therefore, which differed in density, would separate from each other in such a manner, that, if the density of the solar matter be equal to 100, that of Saturn will be equal to 67, of Jupiter, $= 94\frac{1}{2}$, of Mars, $= 200$, of the Earth, $= 400$, of Venus, $= 800$, of Mercury, $= 2800$. But, as the attractive force acts not in proportion to the surface, but to the quantity of matter, it would retard the progress of the more dense parts of the solar matter; and it is for this reason that we find the most dense planets nearest the sun, and which move round him with more rapidity than those which are more distant, and less dense.

The density and projectile motion of Saturn and Jupiter, the two largest planets in the system, have the most exact proportion. The density of Saturn is to that of Jupiter as 67 to $94\frac{1}{2}$, and their velocities are nearly as $88\frac{2}{3}$ to $120\frac{1}{12}$, or as 67 to $90\frac{1}{12}$. How rarely do pure conjectures correspond so exactly to the phænomena of nature! It is true, according to this relation between the celerity and density of the planets, the density of the

earth ought not to exeeed 206$\frac{7}{8}$, instead of 400, which is its real density; hence it may be supposed, that the earth has now double its original density. With regard to the other planets, Mars, Venus, and Mercury, as their densities are only conjectural, we know not whether this circumstance would confirm or weaken our hypothesis. Newton says, that the densities of the planets are proportioned to the degrees of heat they are exposed to; and it is in consequence of this idea that we have mentioned Mars as being one time less dense than the Earth, Venus one time, Mercury seven times, and the comet of 1680, 28,000 times denser than the Earth. But, if we attend to Saturn and Jupiter, the two principal planets, we will find, that this supposed proportion between the densities of the planets, and the heat they sustain, is not well founded: for, according to this hypothesis, the density of Saturn would be as 4$\frac{7}{8}$, and that of Jupiter as 14$\frac{7}{2}$, instead of the proportions of 67 and 94$\frac{1}{2}$; differences so great as to destroy the principles upon which they are founded. Thus, notwithstanding the regard due to the conjectures of Newton, I cannot refrain from thinking that the densities of the planets have a nearer relation to their celerities than to the degrees of heat to which they are exposed. This, indeed, is only a final cause; but the other is a physical relation, the exactness of which is remarkable in Saturn and Jupiter. It is certain, however, that the density of the Earth, instead of being 206$\frac{7}{8}$, is 400; and, consequently, the Earth must have suffered a condensation in the proportion of 206$\frac{7}{8}$ to 400.

But, have the condensations of the planets no relation to the quantity of solar heat they sustain? In that case, Saturn, which was supposed to be at the greatest distance from the sun, would have suffered little or no condensation; and Jupiter would be condensed from 90$\frac{1}{16}$ to 94$\frac{1}{2}$. Now, the sun's heat in Jupiter being to his heat in the Earth as 14$\frac{7}{27}$ to 400, their condensation ought to be in the same proportion. Thus, if Jupiter be condensed as 90$\frac{1}{16}$ to 94$\frac{1}{2}$, the Earth if it had been in the orbit of Jupiter, would have been condensed from 206$\frac{7}{8}$ to 215$\frac{3}{1451}$; but the Earth being much nearer the sun, and receiving heat in proportion to that of Jupiter, as 400 to 14$\frac{7}{27}$, the quantity of condensation it would have undergone in the orbit of Jupiter must be multiplied by the proportion of 400 to 14$\frac{7}{27}$, which will give nearly 234$\frac{1}{7}$ for the condensation the Earth must have received. The density of the Earth was 206$\frac{7}{8}$; by adding its acquired condensation, its actual density will be 400$\frac{1}{8}$, which is nearly the same with 400, its real density determined by the moon's parallax. With regard to the other planets, I pretend not to give exact proportions, but only approximations, tending to shew, that their densities have a strong connection with the celerity of their motions in their respective orbits.

The comet, by falling obliquely on the sun, as mentioned above, must have forced off from his surface a quantity of matter equal to a 650th part of his body. This matter, being in a liquid state, would at first form a torrent, of which the largest and rarest parts would fly to the greatest distances; the smaller and more dense, having received only an equal impulse, would remain nearer the sun; his power of attraction would operate upon all the parts detached from his body, and make them circulate round him; and, at the same time, the mutual attraction of the particles of matter would cause all the detached parts to assume the form of globes, at different distances from the sun, the nearer moving with greater rapidity in their orbits than the more remote.

But, it may be objected, that, if the planets had been detached from the sun, they must have been burning and luminous, not cold and opaque bodies; nothing can have less resemblance to a globe of fire than a globe composed of earth and water; and, by comparison, the matter of the earth is totally different from that of the sun.

It may be replied to this objection, that the matter changed its form after its separation, and that the fire, or light, was extinguished by the projectile motion communicated by the stroke. Besides, may it not be supposed, that the sun, or a burning star, moving with a rapidity equal to that of the planets, would soon be extinguished; and that this may be the reason why all the luminous, or burning stars, are fixed and without motion; and why those called new stars, which have probably changed their stations, are frequently extinguished and disappear? To confirm this remark, comets, when in their perihelia, ought to be inflamed even to their centre; but they never become luminous stars; they only emit a burning vapour, a considerable portion of which they leave behind them in their course.

In a medium which has little resistance, I acknowledge, that fire may subsist, although the burning body be moved with great rapidity. It must likewise be acknowledged, that what I have said applies only to those stars which disappear for ever, not to those that appear and disappear at stated intervals, without changing their situations in the heavens. Of these Maupertius, in his discourse on the figure of the stars, has given a most satisfactory account. But those which have appeared, and then vanished for ever, must unquestionably have been extinguished either by the quickness of their motion, or some other cause. There is not a single example of a luminous star revolving round another; and not one of the planets which revolve round the sun have any light in themselves.

Farther, fire, in small masses, cannot subsist so long as in large ones. The planets would burn a considerable time after they issued from the sun; but, at length, would extinguish for want of combustible matter. For the same reason, the sun itself will be extinguished;

but at a period as much beyond that which extinguished the planets, as the quantity of matter in the sun exceeds that of the planets. However this may be, the separation of the planets from the sun, by the shock of a comet, appears sufficient to account for their extinction.

The earth and planets, when they issued from the sun, were totally composed of liquid fire; in which state they would continue no longer than the violence of the heat that kept them in fusion. But this heat would gradually decay from the moment they left the sun. During their fluid state, they necessarily assumed circular figures; and their diurnal motion would elevate their equators, and flatten their poles. I agree with M. Leibnitz, (Vid. Act. Erud. Lips. an. 1692.) that this figure corresponds so exactly with the laws of hydrostatics, that the earth and planets must necessarily have been once in a state of fluidity occasioned by fire; and, consequently that the interior parts of the earth must be composed of vitrified matter, of which sand, freestone, granite, and perhaps clay, are fragments, or scoriæ.

It is therefore extremely probable, that the planets were originally parts of the sun separated by a stroke which communicated to them a projectile motion; and that their different distances proceeded solely from the difference of their densities. To complete this theory, it only remains to account for the diurnal motion of the planets, and the origin of their satellites; which, instead of adding fresh difficulties, will tend greatly to confirm my hypothesis: for rotation, or what is called diurnal motion, entirely depends on the obliquity of the stroke; an oblique impulse on the surface of a body necessarily gives it a rotatory motion. If the body which receives the impulse be homogeneous, the rotatory motion will always be equal and uniform; but it will be unequal, if the body consist of heterogeneous parts, or of parts different in density. Hence we may conclude, that the matter of each planet is homogeneous, because the diurnal motion of each is uniformly performed in the same time; and this circumstance is an additional proof, that portions of different densities were originally separated from the sun.

But the obliquity of the stroke might be so great as to throw off small quantities of matter from the principal planet, which would necessarily move in the same direction. These parts by mutual attraction, would reunite, according to their densities, at different distances from the planet, follow its course round the sun, and at the same time revolve about the body of the planet, nearly in the plane of its orbit. It is easy to perceive that the portions we mean are the satellites. Thus the formation, position, and motion of the satellites correspond, in the most perfect manner, with our theory; for they all move in the same direction, and in concentric circles round their principal planets, and nearly in the plane of their orbits. All these common effects, depending on an impulsive force, must have proceeded from a common cause, which was a projectile force communicated to them by the same oblique stroke. This account of the motion and formation of the satellites will be strongly supported, if the other circumstances and phænomena attending them be duly weighed. Those planets which are furnished with satellites move quickest round their axes. The revolution of the Earth is quicker than that of Mars, in the proportion nearly of 24 to 15; the Earth has a satellite, and Mars has none; Jupiter, whose diurnal motion is 500 or 600 times more rapid than that of the Earth, has four satellites; and it is extremely probable, that Saturn, who has five satellites and a ring, revolves much more quickly than Jupiter.

We may even conjecture, with some probability, that the plane of the equator of Saturn's ring is nearly the same with that of the planet; for, supposing, according to the preceding theory, the obliquity of the impulse which put Saturn in motion to have been very great, his diurnal motion would at first be in proportion to the excess of the centrifugal force above that of gravity, and, of course, a considerable quantity of matter would be thrown off from his equatorial regions, and necessarily assume the figure of a ring, the plane of which would be nearly the same with that of his own equator. This quantity of matter detached from the equatorial regions of Saturn, must have flattened the equator of that planet; which is the reason why, notwithstanding the rapidity with which we have supposed him to revolve round his axis, the diameters of Saturn are not so unequal as those of Jupiter, which differ from each other more than an eleventh part.

Though this theory of the formation of the planets and their satellites appears to be extremely probable; yet, as every man has his own standard of estimating probabilities of this nature, and as the standard varies according to the different capacities of combining analogies more or less remote, I pretend not to convince those who are unwilling to believe. I have offered these ideas to the public, not only because I thought them rational, and calculated to unravel a subject upon which, however important, nothing has hitherto been written; but because the impulsive motion of the planets gives rise to numberless phænomena in the universe, which admit not of an explanation by gravity alone. To those who may be disposed to deny the possibility of my theory, I would propose the following queries:

1. Is it not natural to imagine, that a moving body has received its motion from the impulse of some other body?

2. When several bodies move in the same direction, is it not exceedingly probable, that they received this direction from a single stroke, or, at least, from strokes every way similar?

3. When several bodies in motion have not only the

same direction, but are placed in the same plane, is it not more natural to think that they received this direction and position from one impulse than from many?

4. Is it not probable, that a body put in motion by impulse, should receive it in an oblique direction; and, consequently, that it should be forced to move round its axis with a rapidity proportioned to the obliquity of the stroke? If these queries be not unreasonable, the theory of which we have given a sketch will no longer have the appearance of absurdity.

Let us now proceed to a more interesting object; let us examine the figure of the earth, upon which so many enquiries and observations have been made. As it appears, from the equality of the Earth's diurnal motion, and the uniformity in the inclination of its axis, that it is composed of homogeneous parts which mutually attract each other in proportion to their quantities of matter; if its impulsive motion had been communicated in a direction perpendicular to its surface, it would necessarily have assumed the figure of a perfect sphere: but, having been struck obliquely, it moved round its axis at the instant it received its figure; and, from the combination of the projectile force and that of attraction, there resulted a spheroid figure, more elevated at the equator than at the poles; because the centrifugal force, arising from the diurnal rotation of the earth, must diminish the action of gravity, or that power which makes all the parts tend to the centre. Thus the earth, being composed of homogeneous parts, and having been endowed with a rotatory motion, must necessarily have assumed a spheroidal figure, the two axes of which differ from each other by a 230th part. To show that this is the real figure of the earth, we need not have recourse to hypotheses; it is capable of the clearest demonstration. The laws of gravitation are well known: that bodies attract each other directly as their quantities of matter, and inversely as the squares of their distances, admits not of a doubt. It can as little be doubted, that the total action of any body is composed of all the particular actions of its parts.

The parts of bodies are all mutually attracted in the above proportion; and all these attractions, when the body has no rotation, necessarily produce a sphere, and a spheroid, when the body is endowed with a rotatory motion. This spheroid is more or less flattened at the poles in proportion to the quickness of the diurnal motion; and the earth, in consequence of the celerity of its rotation, and the mutual attraction of its parts, has assumed the figure of a spheroid, of which the two axes are to one another as 229 to 230.

Thus the earth, at the time of its formation, from the original constitution and homogeneity of its parts, and independent of every hypothesis derived from the direction of gravity, took the figure of a spheroid; and, from the known laws of mechanics, its equatorial diameter was necessarily elevated about six leagues and a half more than its poles.

I shall dwell the longer on this article, because there are some geometers, who, from a system of philosophy they have adopted, and from a supposed direction of gravity, still imagine that the figure of the earth depends upon theory. The first thing to be demonstrated is the mutual attraction of the parts of matter; and the second, the homogeneity of the terrestrial globe. When these two facts are clearly proved, there will be no occasion to have recourse to any theory derived from the direction of gravity; because the earth's figure, in this case, must necessarily be as Newton determined it; and all the other figures assigned to it, in consequence of vortexes and other hypotheses, can have no existence.

It will not be doubted, even by the most incredulous, that the planets are retained in their orbits by the power of gravity. The satellites of Saturn gravitate towards that planet, those of Jupiter towards Jupiter; the Moon gravitates towards the Earth; and Saturn, Jupiter, Mars, the Earth, Venus, and Mercury gravitate towards the Sun. In the same manner, Saturn, Jupiter, and the Earth, gravitate towards their respective satellites, and the Sun gravitates towards the whole planets. Gravitation is therefore a general law, by which the whole planetary system is mutually affected; for action cannot exist without re-action. This mutual attraction of the planets is the law which regulates all their motions; and its existence is demonstrated by its effects. When Saturn and Jupiter are in conjunction, their mutual attraction produces an irregularity in their motion round the Sun. The Earth and Moon also mutually attract each other; but the irregularities in the Moon's motion proceed principally from the attraction of the Sun; and hence the Sun, the Earth, and the Moon, mutually act upon each other. Now, the reciprocal attraction of the planets, when the distances are equal, is proportioned to their quantities of matter; and the same power of gravity, which makes heavy bodies fall to the Earth, and which extends as far as the Moon, is likewise in proportion to the quantity of matter. The total gravity of a planet, therefore, is composed of the gravity of all its parts: hence all the parts of matter, whether in the Earth or planets, mutually attract each other; and, of course, the rotation of the Earth round its axis must necessarily have bestowed on it the figure of a spheroid, the axes of which are as 229 to 230. But the direction of gravity must be perpendicular to the Earth's surface; and, consequently, unless the general and mutual attraction of the parts of matter be denied, no hypothesis derived from the direction of gravity can have any solid foundation. But this mutual attraction, as we have seen, is demonstrated by actual observation; and the experi-

ments made by pendulums prove its universal extension. No hypothesis, therefore, founded on the direction of gravity, can be admitted, without contradicting both reason and experience.

Let us now examine whether the parts composing the terrestrial globe be homogeneous. I acknowledge, that, if the globe be supposed to consist of parts differing in density, the direction of gravity would be different from that we have assigned, and that the earth's figure would vary according to the different suppositions which might be made concerning the direction of gravity. But, why make suppositions of this kind? Why, for example, do we suppose the parts near the centre to be more dense than those more distant from it? Are not all the particles which compose the globe united by their mutual attraction? Every particle, therefore, is a centre; and there is no reason to believe that the parts which surround the centre are denser than those which surround any other point. Besides, if any considerable part of the earth were more dense than another, the axis of rotation would approach nearer that part, and create an inequality in the diurnal revolution of the globe: it would produce an inequality in the apparent motion of the fixed stars; they would appear to move more quickly or slowly in the zenith or horizon, according as we happened to be situated on the heavy or light parts of the earth; and the axis of the globe, not passing through its centre of gravity, would make a perceptible change in its position. But nothing of this kind ever takes place. On the contrary, the diurnal revolution of the earth is equal and uniform. At every point of the earth's surface, the stars appear to move with the same quickness; and, if there be any nutation in its axis, it is too inconsiderable to attract observation. Hence it may be concluded, that all the parts of the globe are at least nearly homogeneous.

If the earth were hollow, the crust of which, for example, exceeded not three leagues in thickness, it would give rise to the following phænomenon. 1. The mountains would bear so great a proportion to the total thickness of the crust, that vast irregularities in the earth's motion would be occasioned by the attraction of the moon and of the sun: when the moon was in the meridian of the more elevated parts, as the Cordeliers, her attraction upon the whole globe would be much greater than when she was in the meridian of the lower parts. 2. The comparative attraction of the mountains would be greatly increased; and the experiments made on Mount Chimboraco in Peru, would have given more degrees in the deviation of the plumb line than they actually gave seconds. 3. The weight of bodies would be greater on the tops of mountains than in the plains; and men would find themselves more weighty, and would walk with more difficulty in high than in low grounds. These observations, and many others which might be made, should convince us, that the interior parts of the earth are not hollow, but that they are composed of matter of a considerable density.

If, on the other hand, the earth, at the depth of two or three leagues, consisted of matter much denser than that we are acquainted with, upon descending even into ordinary pits, we should find ourselves considerably heavier; and the motion of pendulums would there be more accelerated than they actually are when brought down from a hill to a plain. Hence we may presume that the interior parts of the earth consist of matter nearly similar to that on its surface. Of this we shall be still farther convinced, if we consider, that the earth, at the time of its original formation, when it assumed its present spheroidal figure, was in a state of fusion, and, consequently, that all its parts were homogeneous, and nearly of equal density. The matter on the surface, though originally the same with that of the interior parts, has, in the revolutions of time, undergone many changes from external causes; and to these are to be ascribed the production of materials so different in their densities. But, it ought to be remarked, that the densest bodies, as gold, and other metals, are most rarely to be met with; and, consequently, that the greatest quantity of materials, at the surface, have suffered little alteration with regard to density. The most common materials, indeed, as sand and clay, differ so little in density, that we may conjecture, with much probability, the internal parts of the earth to consist of a vitrified matter, the density of which is nearly equal to that of sand; and, consequently, that the whole globe may be considered as one homogeneous mass.

But, it may be said, that, though the earth were composed of concentric beds, of different densities, the equality of its diurnal motion, and the uniform inclination of its axis, would remain equally undisturbed, as upon the supposition of its consisting wholly of homogeneous matter. This I allow; but I demand, at the same time, whether there be any reason for believing that these beds of different densities really exist? Whether this method of solving difficulties be not an attempt to adjust the works of nature to our own imaginations? And whether suppositions, neither founded on observation nor analogy, ought to find admittance into physical reasoning?

Hence, it is apparent, that the earth received its spheroidal figure in consequence of its diurnal motion, and the mutual attraction of its parts; that this figure necessarily resulted from the globe's being in a liquid state; that, according to the laws of gravity and a centrifugal force, it could not possibly assume any other figure; that, at the moment of its formation, the difference between its two diameters, was, as at present, equal

to a 230th part; and, of course, that all other hypotheses which make this difference greater or less, are mere fictions, and deserve no attention.

Perhaps it may be objected, that, if this theory be well founded, and if the proportion of the axes of the two diameters be as 229 to 230, how came the mathematicians sent to Lapland and Peru to concur in making it as 174 to 175? Why should such a difference subsist between practice and theory? And, is it not more reasonable to give the preference to actual measurement, especially when executed by the ablest mathematicians in Europe, (M. de Maupertuis, Figure de la Terre,) and furnished with all the necessary apparatus?

To this I reply, that I mean not to combat the observations made at the equator, and near the pole; that I doubt not of their exactness; and that the earth may actually be elevated a 175th part more at the equator than at the poles. Still, however, I maintain my theory; and I perceive clearly how it may be reconciled to practice. The difference between the two conclusions is about four leagues in the two axes. The equatorial regions are found to have an elevation of two leagues more than they ought to have by the theory. This height of two leagues corresponds exactly with the greatest inequalities which have been produced on the surface of the globe by the motion of the sea, and the action of fluids. Here some illustration is necessary. At the time of the earth's formation, in consequence of the mutual attraction of its parts, and of its centrifugal force, it must have assumed a spheroidal figure, with its axes different by a 230th part. This would be the real figure of the earth while it remained in a state of liquifaction. But, after cooling for some time, the rarified vapours, like those in the tail or atmosphere of a comet, would condense, and fall on the surface in the form of air and water; and, when these waters begin to be agitated by a flux and reflux, sand, and other bodies, would be gradually transported from the poles towards the equatorial parts. This operation, when continued for some time, would necessarily sink the poles, and elevate the equator in the same proportion. The surface of the earth, being likewise exposed to the winds, to the action of the air and of the sun; all these causes would concur with the tides in furrowing the earth, in scooping out valleys, in elevating the mountains, and in producing other superficial irregularities, none of which, perhaps, exceed a league in thickness, even at the equator. This inequality of two leagues may be supposed to be the greatest that can take place on the surface; for the highest mountains exceed not a league in height; and the most profound parts of the ocean, it is probable, are not above a league in depth. Thus my theory perfectly coincides with practice. The earth's equator could not, at first, be elevated more than six leagues and a half above the poles; but the changes produced on the surface might give it a still greater elevation. Natural history wonderfully supports this opinion; for, in the preceding discourse, we have proved, that, from the tides and other motions of the waters, have proceeded mountains, and all the other inequalities on the surface of the globe; and that, at great depths, as well as upon the greatest heights, bones, shells, and other relicks of sea and land animals have been discovered.

From what has been observed, it may be conjectured, that, in order to find primitive earth, and substances which have never been removed from their original stations, we must dig in countries near the poles, where the bed of unmoved earth will be thinner than in southern climates.

In fine, if the measurement by which the figure of the earth was determined be strictly scrutinized, we shall find that it is not altogether free from hypothetical reasoning: for it proceeded on the suppostion that the earth was a regular curve. But, as the earth is liable to considerable and constant changes from a thousand causes, it is impossible that it could have retained any perfectly regular figure; and hence, agreeably to our theory, and the opinion of Newton, the poles might originally be only flattened a 230th part. Besides, though we have the exact length of a degree at the equator and polar circle, yet we have not the exact length of a degree in France; and the measures of M. Picard have never been confirmed. It may be added, that the diminution and increase in the motion of the pendulum agree not with the conclusions drawn from measurement; and that, on the contrary, they correspond very nearly with the theory of Newton. These circumstances tend farther to convince us, that the poles are not depressed above a 230th part; and that, if there be any difference, it can proceed from nothing but the inequalities produced on the surface by the waters, and other external causes. But these inequalities are by no means so regular as to justify any hypothesis which supposes the meridians to be ellipses, or any other perfect curves. Hence it appears, that, though many degrees should be successively measured in different regions, we cannot, by that alone, ascertain the exact depression of the poles, nor determine how much it exceeds or falls short of a 230th part.

May we not likewise conjecture, that, if the inclination of the earth's axis has been changed, this effect could not be produced but by the changes on the surface, since all the other parts are homogeneous; that this variation is, of course, too small to be perceived by astronomers; and that, if the earth be not disturbed by a comet, or some other external cause, its axis will for ever preserve its present and original inclination?

Not to omit any conjecture that seems reasonable, may we not suppose, that, as the mountains and other inequalities on the surface of the earth, have originated

from the action of the tides, those which we perceive in the moon have been produced by a similar cause? The mountains of the moon are indeed higher than those of the earth; but her tides are likewise stronger; because the earth, the size of which is much larger, raises the tides of the moon with a superior force. This effect would be greatly augmented, if the moon, like the earth, had a quick diurnal motion. But, as the moon uniformly presents the same face to the earth, the tides are raised only in proportion to the motion occasioned by her librations, which alternately expose to our view a small segment of her other hemisphere. This cause, however, must produce tides very different from those of our seas; and their effects will, of course, be much less considerable, than if the moon had possessed a diurnal revolution round her axis, equally quick as the rotation of the earth.

I should compose a volume equal to that of Burnet or Whiston, were I to extend the ideas presented by the above theory; and were I, in imitation of the last mentioned author, to clothe them in a geometrical dress, I might add considerably to their importance. But I have always thought, that hypotheses, however probable, deserve not to be treated so pompously. It is apt to give them the air of quackery and imposition.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE II.

Of the System of Whiston.

(See a New Theory of the Earth, by Will. Whiston, London, 1708.)

THIS author begins his theory with a dissertation on the creation of the world. He alleges, that the account given of it by Moses is not properly understood; and that, in inquiries of this kind, men, contenting themselves with the most evident and superficial views, give too little of their attention to nature, reason, and philosophy. The common notions, he observes, concerning the six days' work, are false; and the description of Moses is not an exact or philosophic account of the creation and origin of the universe, but only an historical narrative of the formation of the terrestrial globe. The earth, in his estimation, formerly existed in Chaos, and, at the time mentioned by Moses, it only received a form, situation, and consistence, necessary for the habitation of mankind. I shall not give a detail of Whiston's proofs, nor enter upon a formal refutation of them, but content myself with a short view of his theory, which will shew it to be contrary to the scriptures, and, of course, that his proofs must be false. Besides, he treats this matter more like a polemical divine than a philosopher.

Leaving these false principles, he proceeds to some ingenious notions, which, though singular, will not, to those who are influenced by the enthusiasm of system, appear to be destitute of probability. He tells us, that the ancient Chaos, from which the earth originated, was the atmosphere of a comet; that the annual motion of the earth began when it received its new form; but that its diurnal motion commenced not till the fall of Adam; that the ecliptic cut the tropic of Cancer in a point precisely opposite to Paradise, which was situated on the north-west frontier of Assyria; that, before the deluge, the year began at the autumnal equinox, and that the orbits of the earth and planets were then perfect circles; that the deluge commenced on the 18th of November, in the year of the Julian period 2365 or 2349 before Christ; that, previous to the deluge, the solar and lunar year were the same, and consisted exactly of 360 days; that a comet, descending in the plane of the ecliptic to its perihelion, on the very day that the deluge began, made a near approach to the earth; that there is a great heat in the bowels of the earth, which is constantly expanding from the centre to the circumference; that the figure of the earth resembles an egg; that the mountains are the lightest parts of the globe, &c. He then attributes to the deluge all the changes the earth has undergone, blindly adopts Woodward's theory, uses indiscriminately all that author's remarks on the present state of the earth; but assumes more the air of an original, when he treats of its future condition. The earth, says Mr. Whiston, will be consumed by fire; and its destruction will be preceded by earthquakes, thunder, and hideous meteors; the sun and moon will assume a dreadful aspect; the heavens will seem to fall; and the whole earth will be in flames. But, after the fire shall have devoured every impurity of this globe, and vitrified

and rendered it transparent as the purest crystal, the saints and spirits of the blessed shall take possession of it, and there remain till the general judgment.

This hypothesis appears, at first view, to be extravagant and fantastical. But the author has managed his ideas with such dexterity, and placed them in so strong a light, that they no longer have the air of absolute chimeras. He has adorned his subject with much science and ingenuity: and it is astonishing, that, from such a medley of strange notions, he should have been able to compose a system so plausible. But it is not to the vulgar that it has this brilliant appearance; the learned are more easily deceived by the glare of erudition, and the force of new ideas. Mr. Whiston was a celebrated astronomer. Accustomed to contemplate the heavens, to measure the motions of the stars, and to consider the great phænomena of nature, he could never imagine that this grain of sand, which we inhabit, occupied more the attention of its Creator than the universe, which contains, in the vast regions of space, millions of other suns and other worlds. He alledges, that Moses has not given us the history of the first creation of this globe, but only a detail of those circumstances which attended its receiving a form fit for the habitation of men, when the Almighty transformed it from the state of a comet to that of a planet. Comets, owing to the eccentricity of their orbits, are subject to dreadful vicissitudes: sometimes, like that of 1680, they are a thousand times hotter than melted iron, and sometimes a thousand times colder than ice: they cannot, therefore, furnish habitation to any creatures of which we can form a conception; or rather, they are altogether uninhabitable.

The planets, on the contrary, are tranquil bodies; their distances from the sun vary but little; and their temperature continues so nearly the same, that it permits plants and animals to grow and to multiply.

In the beginning, says Mr. Whiston, God created the universe; but the earth was then an uninhabitable comet, and subject to such alternate extremes of cold and heat, that its matter, being sometimes liquified and sometimes frozen, was in the form of a chaos, or an abyss, surrounded with utter darkness: *And darkness covered the face of the deep.* This chaos was the atmosphere of the comet, a body composed of heterogeneous materials, having its centre occupied with a globular, solid, hot nucleus, of about 2000 leagues in diameter, round which was an extensive mass of a thick fluid, mixed with heterogeneous and undigested materials, like the chaos of the ancients, *rudis indigestaque moles.* This great atmosphere contained few dry, solid, or earthy particles, and still less of water or air; but it was amply filled with thick and heavy fluids, mixed, agitated, and jumbled together in the utmost confusion. Such was the condition of the earth when six days old: but, next day, that is, on the first day of the creation, when the eccentric orbit of the comet was changed into an ellipse, nearly circular, every thing assumed its proper place; the different materials arranged themselves according to their specific gravities; the heavy fluids sunk down, and left to the earthy, watery, and aërial substances, the superior regions. These also descended in the order of their gravities; first, the earth, then the water, and, lastly, the air. In this manner, the immense volume of chaos was reduced to a moderate sphere, the centre of which is a solid body that still retains the heat it received from the sun, when formerly the nucleus of a comet. This heat may easily last 6000 years, since the comet of 1680 would require 50,000 before it cooled. Round the solid and burning nucleus, at the centre of the earth, is placed the heavy fluid which descended first, and formed the great abyss, upon which the earth floats like a cork on quicksilver. But, as the earthy parts were originally mixed with a great body of water, they, in descending, drove before them a part of this water, which was confined there when the earth consolidated, and formed a stratum concentric with the heavy fluid that surrounds the nucleus. Thus, the great abyss is composed of two concentric circles, the interior being a heavy fluid, and the superior water, upon which last the earth is immediately founded. From this admirable arrangement, produced by the atmosphere of a comet, are to be deduced the theory of the earth, and an explication of all its phænomena!

After the atmosphere of the comet had been freed from the solid and earthy particles, a pure air only remained, through which the rays of the sun instantly penetrated, and produced light: *Let there be light; and there was light.* The vast columns or beds of which the earth is composed, being formed with so much precipitation, is the reason why they differ so much in density; the heavier sunk deeper into the abyss than the lighter, and, of course, gave rise to mountains and vallies: these inequalities, before the deluge, were differently situated from what they are at present. Instead of that vast valley which contains the ocean, many small caverns were dispersed over the globe, each of which contained a part of the waters. The mountains were then at greater distances, and formed not large chains. But the earth was a thousand times more fertile, and contained a thousand times more inhabitants; and the life of man, and of the other animals, was ten times longer. All these effects were produced by the superior heat of the central fire, which gave birth to a greater number of plants and animals, and, at the same time, bestowed on them a degree of vigour that enabled them to exist long, and to multiply abundantly. But this heat had a miserable effect upon the dispositions of men and other animals: it augmented the passions, robbed man of his

innocence, and diminished the sagacity of the brute creation. All creatures, except the fishes, who inhabited a colder element, felt the influence of the central heat, became vicious, and merited death. This universal death was accordingly inflicted, on Wednesday the 28th day of November, by a dreadful deluge, which lasted 40 days and 40 nights, and was occasioned by the tail of a comet meeting with the earth, in returning from its perihelion.

The tail of a comet is the lightest part of its atmosphere. It is a transparent and subtile vapour raised by the heat of the sun from the body of the comet. This vapour, which is composed of aërial and watery particles extremely rarified, follows the comet in its descent to its perihelion, and goes before the comet in its ascent, its situation being always opposite to the sun, as if it had an affection for the shade, and wishing to avoid the scorching rays of the sun. This column of vapour is often of an immense extent; and its length always increases in proportion as the comet approaches nearer the sun. Now, as many comets descend below the annual orbit of the earth, it is not surprising that the earth should sometimes be involved in this vapour. This dreadful event happened at the time of the deluge. The tail of a comet, in two hours, will discharge a quantity of water equal to that contained in the whole ocean. In fine, this tail is what Moses calls the cataracts of heaven: *And the cataracts of heaven were opened.* The globe of the earth, when it meets with a comet's tail, must necessarily, in its passage through this body of vapour, appropriate part of its materials. Every thing that comes within the sphere of the earth's attraction must fall upon it, and must fall in the form of vapour, since the tail itself principally consists of that element. In this manner, rain may come from the heavens in such torrents, as to produce an universal deluge, and to surmount the tops of the highest mountains.

Our author, however, unwilling to go beyond the letter of the sacred writings, does not ascribe the deluge to this rain alone, which he has chosen to bring from so great a distance. He takes advantage of water wherever he can find it: the great abyss, as we have seen, contains a considerable quantity. The earth, in its approach towards the comet, would feel the force of its attraction; the waters in the great abyss would be so agitated with a motion similar to that of the tides, as would necessarily break the shell or crust in many places, and make the water rush out upon the surface: *And the fountains of the abyss were opened.*

But how, it may be asked, was this vast collection of water, so liberally furnished by the great abyss, and by the comet's tail, afterwards disposed of? Our author is not embarrassed by this circumstance. As soon as the earth escaped from the comet, the flux and reflux of the great abyss necessarily ceased. From that moment, the waters on the surface rushed down with violence by the same channels out of which they had issued. The great abyss swallowed up not only its own water, but all that had been deposited by the comet, which it was sufficiently enabled to contain; because, during its agitation, and when it broke the crust, it had greatly enlarged its dimensions, by pushing the earth farther from it on all sides. It was at this time, likewise, that the earth, which was formerly a sphere, assumed its elliptical figure. This effect was produced by the centrifugal force occasioned by the diurnal motion of the earth, and by the attraction of the comet; for the earth, when passing through the tail of the comet, was so situated, that its equatorial parts were nearest that star; and, of course, the power of the comet's attraction, concurring with the earth's centrifugal force, elevated the equatorial regions with the greater facility, because the crust was broken in an infinite number of places, and because the flux and reflux of the abyss pushed more violently against the equator than any where else.

This is the history Mr. Whiston gives of the creation, of the causes of the universal deluge, of the longevity of the antediluvians, and of the figure of the earth. All these difficult subjects seem to have given our author very little trouble. But he appears to be greatly puzzled concerning Noah's ark. In that dreadful confusion, produced by the conjunction of the tail of a comet, and by the waters of the great abyss, and in that horrible period, when not only the elements of this globe were confounded, but when the heavens concurred with the bowels of the earth in producing new elements to increase the chaos, how is it to be imagined that the ark could float tranquilly, with its numerous and valuable cargo, upon the surface of the waves? Here our author struggles hard, in order to account for the preservation of the ark. But, as his reasoning upon this subject appears to be inconclusive, ill-imagined, and heterodox, I shall only observe how hard it is for a man, who had explained objects so great and surprising, without having recourse to a supernatural power, to be stopped in his career by a trifling circumstance. But he chooses to risk drowning himself along with the ark, rather than to ascribe the preservation of this precious vessel to the interposition of the Almighty!

I shall only make a single remark upon this system, of which I have given a faithful abridgment. Whenever men are so presumptuous as to attempt a physical explanation of theological truths; whenever they allow themselves to interpret the sacred text by views purely human; whenever they reason concerning the will of the Deity, and the execution of his decrees; they must necessarily involve themselves in obscurity, and tumble into a chaos of confusion, like the author of this whimsical system, which, notwithstanding all its absurdities, has been received with great applause. Mr. Whiston

neither doubted of the truth of the deluge, nor of the authenticity of the sacred writings. But, as physics and astronomy occupied his principal attention, he mistook passages of holy writ for physical facts, and for results of astronomical observations; and so strangely jumbled divinity with human science, that he has given birth to the most extraordinary system that perhaps ever did or ever will appear.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE III.

Of Burnet's Theory.

(Thomas Burnet. Telluris theoria sacra, orbis nostri originem et mutationes generales, quas aut jam subiit, aut olim subiturus est, complectens. Londini 1681.)

MR. BURNET is the first author who discovered enlarged views of the present subject, and who treated of it in a systematic manner. He was a man of genius and of taste: his work acquired great reputation, and was, of course, criticised by many of the learned, and, among others, by Mr. Keill, who, scrutinizing the subject as a geometer, demonstrated the errors of Burnet's theory in a treatise entitled, *An Examination of the Theory of the Earth.* Mr. Keill likewise refuted the system of Whiston; but he treated the latter in a manner very different from the former. He even appears, in many particulars, to adopt the opinions of Whiston; and considers the notion, that the deluge was occasioned by the tail of a comet, as exceedingly probable. But, to return to Burnet: his book is written with elegance. He knows how to paint the grandest images and the most magnificent scenes. His plan is elevated; but, being defective in proper materials, he often fails in the execution. His reasonings and his proofs are feeble; but the boldness with which he writes makes the reader lose sight of all his imperfections.

He begins with alledging, that the earth, before the deluge, was very different from what it is now. It was at first, says he, a fluid mass, composed of matters of every species, and of all kinds of figures, the heaviest of which descended to the centre, and formed a hard and solid body. The waters took their station round this body; and all lighter fluids rose above the water. Thus, between the coat of air, and that of water, a coat of oily matter was interposed. But, as the air was then full of impurities, and contained great quantities of earthy particles, these gradually subsided upon the coat or stratum of oil, and formed a crust composed of earth and oil: this crust was the first habitable part of the earth, and the first abode of man and other animals. The land thus formed was light, fat, and adapted to cherish the tenderness of the original germs. The surface of the earth was level and uniform, without mountains, seas, or other inequalities. But it it remained in this state about sixteen centuries only; for the heat of the sun gradually drying the crust, produced, at first, superficial fissures or cracks only; but, in process of time, these fissures penetrated deeper, and increased so much in their dimensions, that, at last, they entirely perforated the crust. In an instant, the whole earth split in pieces, and fell into the great abyss of waters which it formerly surrounded. This wonderful event was the universal deluge.

But all these masses of earth, in falling into the abyss, carried along with them vast quantities of air, and they dashed against each other, and accumulated and divided so irregularly, that great cavities filled with air were left between them. The waters gradually opened passages into these cavities, and, in proportion as the cavities were filled with the water, the surface of the earth began to discover itself in the most elevated places; and, at last, the waters appeared no where but in those extensive valleys which contain the ocean. Thus our ocean is a part of the ancient abyss; the rest of it remains in the internal cavities, with which the sea has still a communication. Islands and sea-rocks are the small fragments, and continents are the large masses of the ancient crust. As both the rupture and fall of this crust were effected in a sudden and confused manner, it is not surprising that the surface of the present earth should be full of mountains, gulfs, plains, and irregularities of every kind.

This specimen is sufficient to give an idea of Burnet's system. It is an elegant romance, a book which may be read for amusement, but cannot convey any instruction. The author was ignorant of the chief phænomena of the earth, and a man of no observation. He has drawn every thing from imagination, which often acts both against truth and reason.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE IV.

Of the System of Woodward.

(An Essay towards the Natural History of the Earth, by John Woodward.)

OF this author, it may be said, that he wanted to build an immense edifice upon a foundation less firm than sand, and to construct a world with dust; for he asserts, that the earth, at the time of the deluge, suffered a total dissolution. In perusing his book, the first idea which presents itself is, that this dissolution was effected by the waters of the great abyss. He alledges, that, at the command of God, the abyss suddenly opened, and diffused such an enormous quantity of water on the surface, as was sufficient to cover the tops of the highest mountains; and that God suspended the law of cohesion, which instantly reduced every solid substance into a powder, &c. He did not consider, that, by these suppositions, he added to the miracle of the universal deluge many other miracles, or, at least, physical impossibilities, which accord neither with the scriptures, nor with the principles of mathematics and of natural philosophy. But as this author has the merit of collecting many important observations, and as he knew better than any former writer the materials of which the globe is composed, his system, though ill conceived, and worse arranged, has seduced, by the lustre of a few striking facts, many weak men into a belief of his general conclusions.

We shall now give a short view of his theory, by which we shall be enabled to do justice to the merit of the author, and put the reader in a condition to judge of the futility of his system, and of the falsehood of some of his remarks. Mr. Woodward informs us, that he recognised with his own eyes all the materials of which the earth in England is composed, from the surface to the greatest depths that had been dug; that they were all disposed in beds, or strata; and that in many of these beds, there are shells and other productions of the sea. He then adds, that he was assured by his friends and correspondents, that, in all the other countries of the world, the earth was composed of the same materials; and that shells are found, not only in the plains, and in some particular parts, but on the highest mountains, in the deepest pits, and in an infinite number of different places. He observed, that the beds were all horizontal, and placed over each other, like matters transported by the waters, and deposited in the form of sediment. These general remarks, which are founded in truth, are followed with some particular observations, by which he demonstrates, that the fossil shells incorporated with the strata, are real sea-shells, and not peculiar minerals, or *lusus naturæ*, &c.

To these observations, though partly made before him, he has added others of a more suspicious nature. He asserts, that the materials of the different strata are arranged according to their specific gravities. This assertion is not consistent with truth: for we every day see solid rocks placed above clay, sand, pit-coal, bitumen, and other comparatively light bodies. If, indeed, it were uniformly found, through the whole earth, that the upper stratum was bitumen, followed successively by strata of chalk, marl, clay, sand, stone, marble, and metals, it would, in that case, be probable that all those materials had been precipitated at once: and this our author affirms with confidence, though the most superficial observer needs only his eyes to convince him, that heavy strata are often found above light ones; and, consequently, that these sediments could not be deposited at the same time, but must have been transported and deposited by the ocean at successive periods. As this is the foundation of Woodward's system, and is manifestly false, we shall follow him no farther than to show how an erroneous principle produces false relations, and bad conclusions.

All the strata which compose the earth, says our author, from the tops of the highest mountains to the deepest mines, are placed according to their respective specific gravities. Hence, he concludes, the whole must have been in a state of dissolution, and precipitated at the same time. But at what time, in what menstruum, was it dissolved? In the water, says Mr. Woodward, and at the time of the deluge. But there is not water enough on the globe to produce this effect; for there is more earth than water; and the bottom of the sea itself is earth. Very well, he replies; but there is enough of water in the central parts of the earth; and nothing more was wanting than to bestow on it the power of dissolving every terrestrial substance except sea-shells; to find a proper method of making the waters return to the abyss; and to make all this correspond with the

history of the deluge. Behold a system, of which the author could not prevail on himself to form a doubt; for, when it was objected to him, that water could not dissolve water, rocks, and metals, especially in forty days, the time of the waters remaining on the earth; he replied simply, that the event, however, did happen. When it was demanded of him, how the waters of the abyss could dissolve the whole earth, and yet preserve the shells? He answered, that he never proved that this water was a dissolvent; but that, from facts, it was clear that the earth had been dissolved, and that the shells were preserved. Lastly, when it was demonstrated to him, that his system was useless, as it was neither supported by reason nor by facts; he said, we had only to suppose that, at the time of the deluge, the laws of gravity and of cohesion were suddenly stopped, and, upon this supposition, the dissolution of the ancient world admitted of an easy explanation. But, it was observed to him, if the force of cohesion were suspended, why were not the shells dissolved along with the rest? Here he gave an harangue on the organization of shells and animal bones, tending to prove that their texture was fibrous, and different from that of minerals; that their cohesion was likewise different; and that, after all, we have only to suppose that the powers of gravity and of cohesion did not entirely cease, but that they were diminished to such a degree, as enabled them to dissolve the parts of minerals, but not those of animals. I shall conclude with remarking, that our author's philosophy was not equal to his talent for observation; it is therefore unnecessary to give a formal refutation of absurd notions, especially when they proceed upon conjectures which are contrary both to the laws of probability and mechanics.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE V.

Examination of some other Systems.

THE three hypotheses formerly animadverted upon have many things in common: They all agree in this, that, at the time of the deluge, both the external and internal form of the earth was changed. But none of these theorists considered, that the earth, before the deluge, was inhabited by the same species of men and animals; and, consequently, that it must have been nearly the same, both in figure and structure, as it is at present. We are informed by the Sacred Writings, that, before the deluge, there were rivers, seas, mountains, and forests; that most of these mountains and rivers remained nearly in their former situation; the Tigris and Euphrates, for example, ran through Paradise; that the Armenian mountain on which the ark rested, was, at the deluge, one of the highest mountains of the earth, as it is at this day; and that the same plants and the same animals, which inhabited the earth before the deluge, continue still to exist; for we are told of the serpent, the crow, and the pigeon that carried the olive-branch into the ark. Tournefort indeed alledges, that there are no olives within 400 leagues of Mount Ararat, and affects to be witty on this head. It is, however, indisputable, that there were olives in the neighbourhood of this mountain at the time of the deluge; for Moses assures us of the fact in the most express manner. Besides, it is not surprising, that, in the course of 4,000 years, the olives should be extirpated in these provinces, and multiplied in others. It is, therefore, contrary both to Scripture and reason, that these authors have supposed the earth, before the deluge, to have been totally different from what it is now; and this opposition between their hypotheses and the Sacred Writings, as well as sound philosophy, is sufficient to discredit their systems, although they should correspond with some phænomena, (see Voyage du Levant, vol. ii. p. 336.) Burnet, who wrote first, gives neither facts nor observations in support of his system. Woodward's book is only a short essay, in which he promises much more than he was able to perform; it is only a project, without any degree of execution. He makes use of two general remarks, 1. That the earth is every where composed of materials which had formerly been in a state of fluidity, and which had been deposited by the waters in horizontal beds. 2. That, in the bowels of many parts of the earth, there are an infinite number of sea bodies. To account for these facts, he has recourse to the universal deluge; or rather, he appears to employ these as proofs of the deluge. But, like Burnet, he falls into evident contradictions; for it is absurd to suppose, with these authors, that. before the deluge, there were no

mountains, since we are expressly told, that the waters rose 15 cubits above the tops of the highest mountains. On the other hand, it is not said that the waters destroyed or dissolved the mountains. In the place of this extraordinary dissolution, the mountains remained firm in their original situations, and the ark rested upon the one which was first deserted by the waters. Besides, it is impossible to imagine, that, during the short time the deluge continued, the waters could dissolve the mountains, and the whole fabric of the earth. Is it not absurd to suppose, that, in the space of forty days, the hardest rocks and minerals were dissolved by simple water? Is it not a manifest contradiction to admit this total dissolution, and yet to maintain that shells, bones, and other productions of the sea, were able to resist a menstruum to which the most solid materials had yielded? Upon the whole, I cannot hesitate in pronouncing, that Woodward, though furnished with excellent facts and observations, has produced but a weak and inconsistent theory.

Whiston, who wrote last, has greatly improved upon the other two; and though he has given loose reins to his imagination, it cannot be said that he falls into contradiction. He advances many things which are incredible; but they are neither absolutely nor apparently inpossible. As we are ignorant of what materials the centre of the earth is composed, he thinks himself entitled to suppose it a solid nucleus, surrounded with a ring of heavy fluid matter, and then follows a ring of water, upon which the external crust is supported. In this ring of water, the different parts of the crust sunk more or less in proportion to their gravities, and gave rise to mountains and inequalities on the surface of the earth. But our astronomer here commits a blunder in mechanics. He considered not, that the earth, on this supposition, must have formed one uniform arch; and, consequently, that it could not be supported by the water, and far less could any part of this arch sink deeper than another. If this be excepted, I doubt whether he has fallen into any other physical blunder: he has, however, committed many errors both in metaphysics and theology. In fine, it cannot be denied absolutely, that the earth, in meeting with the tail of a comet, would be deluged, especially if it be allowed to the author, that the tails of comets contain watery vapours. Neither, is it absolutely impossible, that the tail of a comet, in returning from its perihelion, should burn the earth, if we suppose, with Mr. Whiston, that the comet passed very near the sun's body. The same observations may be made upon the rest of his system. But, though his notions be not absolutely impossible, when taken separately, they are so exceedingly improbable, that the whole assemblage may be regarded as exceeding the bounds of human credulity.

These three are not the only books which have been written upon the theory of the earth. In 1729, M. Bourguet published, along with his *Philosophical Letters on the Formation of Salts*, &c. a memoir, in which he gives a specimen of a system which he had projected; but the execution of it was prevented by the death of the author. It must be acknowledged, that no man was more industrious and acute in making observations, and in collecting facts. To him we are indebted for remarking the correspondence between the angles of mountains, which is the chief key to the theory of the earth. He arranges the materials he had collected in the best order. But, with all these advantages, it is probable, that he would not have succeeded in giving a physical history of the changes which have happened in the earth; and he appears not to have discovered the causes of those effects which he relates. To be convinced of this remark, we have only to take a view of the propositions he deduces from those phænomena which must have been the foundation of his theory. He says, that the earth was formed at once, and not successively; that its figure and disposition demonstrate that it was formerly in a fluid state; that the present condition of the earth is very different from what it was some ages after its first formation; that the matter of the globe was originally more soft than after its surface was changed; that the condensation of its solid parts diminished gradually with its velocity; so that, after a certain number of revolutions round its own axis, and round the sun, its original structure was suddenly dissolved; that this happened at the vernal equinox; that the sea-shells insinuated themselves into the dissolved matters; that the earth, after its dissolution, assumed its present form; and that, as soon as the fire or heat operated upon it, its consumption gradually began, and, at some future period, it will be blown up with a dreadful explosion, accompanied with a general conflagration, which will augment the atmosphere, and diminish the diameter of the globe; and then the earth, in place of strata of sand or clay, will consist only of beds of calcined materials, and mountains composed of amalgams of different metals.

This is a sufficient view of the system which M. Bourguet designed to compose. To guess at the past, and to predict the future, nearly in the same manner as others have guessed and predicted, requires but a small effort of genius. This author had more erudition than sound and general ideas. He appears not to have had the capacity of forming enlarged views, or of comprehending the chain of causes and effects.

In the Leipsic Transactions, the celebrated Leibnitz published a sketch of an opposite system, under the title of Protogæa. The earth, according to Bourguet and others, was to be consumed by fire. But Leibnitz maintains, that it originated from fire, and that it has undergone innumerable changes and revolutions. At the time that Moses tells us the light was divided from

the darkness, the greatest part of the earth was in flames. The planets, as well as the earth, were originally fixed and luminous stars. After burning for many ages, he alledges, that they were extinguished from a deficiency of combustible matter, and that they became opaque bodies. The fire, by melting the matter, produced a vitrified crust; and the basis of all terrestrial bodies is glass, of which sand and gravel are only the fragments. The other species of earth resulted from a mixture of sand with water and fixed salts: and, when the crust had cooled, the moist particles, which had been elevated in the form of vapour, fell down, and formed the ocean. These waters at first covered the whole surface, and even overtopped the highest mountains. In the estimation of this author, the shells, and other spoils of the ocean, which every where abound, are indelible proofs that the earth was formerly covered with the sea; and the great quantity of fixed salts, of sand, and of other melted and calcined matters shut up in the bowels of the earth, demonstrate, that the conflagration had been general, and that it had preceded the existence of the ocean. These ideas, though destitute of evidence, are elevated, and bear conspicuous marks of ingenuity. The thoughts have a connection, the hypotheses are not impossible, and the consequences which might be drawn from them are not contradictory. But the great defect of this theory is, that it applies not to the present state of the earth. It only explains what passed in ages so remote, that few vestiges remain; a man may, therefore, affirm what he pleases, and what he says will be accompanied with more or less probability, in proportion to the extent of his talents. To maintain, with Whiston, that the earth was originally a comet, or with Leibnitz, that it was a sun, is to assert what is equally possible or impossible; it would, therefore, be ridiculous to investigate either by the laws of probability. The instantaneous creation of the world destroys the notion of the globe's being covered with the ocean, and of that being the reason why sea-shells are so much diffused through different parts of the earth; for, if that had been the case, it must of necessity be allowed, that shells, and other productions of the ocean, which are still found in the bowels of the earth, were created long prior to man, and other land-animals. Now, independent of Scripture-authority, is it not reasonable to think that the origin of all kinds of animals and vegetables is equally ancient?

M. Scheutzer, in a dissertation addressed to the Academy of Sciences in 1708, attributes, like Woodward, the change, or rather new creation of the globe, to the deluge. To account for the formation of mountains, he tells us, that God, when he ordered the waters to return to their subterraneous abodes, broke, with his Almighty hand, many of the horizontal strata, and elevated them above the surface of the earth, which was originally level. The whole dissertation was composed with a view to support this ridiculous notion. As it was necessary that these eminences should be of a solid consistence, M. Scheutzer remarks, that God only raised them from places which abounded in stones. Hence, says he, those countries, like Switzerland, which are very stony, are likewise mountainous; and those, like Flanders, Holland, Hungary, and Poland, which are mostly composed of sand and clay to great depths, have few or no mountains. (Vid. Hist. de l'Acad. 1708, p. 32.)

This author, like Woodward, blends physics and theology; and, though he has made some good observations, the systematic part of his work is weaker and more puerile than that of any of his predecessors. He has even descended to declamation, and absurd pleasantries. The reader, if he desires to see them, may consult his *Piscium Querelæ*, &c. not to mention his *Physica Sacra*, consisting of several volumes in folio, a weak performance, fitter for the amusement of children than the instruction of men.

Steno, and some others, have attributed the origin of mountains, and other inequalities upon the surface of the earth, to particular inundations, earthquakes, &c. But the effects of these secondary causes could produce nothing but slight changes. These causes may co-operate with the first cause, namely, the tides, and the motion of the sea from east to west. Besides, Steno has given no theory, nor even any general facts, upon this subject. (Vid. Dissert. de Solido intra Solidum nato, &c.)

Ray alledges, that all mountains have been produced by earthquakes, and has written a treatise to prove the point. When we come to the article of volcanoes, we shall examine the foundation of this opinion.

We cannot omit observing here, that Burnet, Whiston, Woodward, and most other authors, have fallen into an error which deserves to be rectified. They uniformly regard the deluge as an effect within the compass of natural causes, although the Scripture represents it as an immediate operation of the Deity. It is beyond the power of any natural cause to produce on the surface of the earth a quantity of water sufficient to cover the highest mountains: and, although a cause could be imagined adequate to this effect, it would still be impossible to find another cause capable of making the waters disappear. Granting that Whiston's waters proceeded from the tail of a comet, we deny that any of them could issue from the abyss, or that the whole could return into it; for the abyss, according to him, was so environed and pressed on all sides by the terrestrial crust, that it was impossible the comet's attraction could produce the least motion in the fluids it contained, far less any motion resembling the tides: hence, not a single drop could either proceed from, or enter into the great abyss. Unless, therefore, it is supposed, that the waters which fell from the comet were annihilated by a miracle, they would for ever have remained on the sur-

face, and covered the tops of the highest mountains. The impossibility of explaining any effect by natural causes, is the most essential character of a miracle. Our authors have made several vain efforts to account for the deluge. Their errors in physics, and in the secondary causes they employ, prove the truth of the fact, as related in Scripture, and demonstrate, that the universal deluge could not be accomplished by any other cause than the will of the Deity.

Besides, it is apparent, that it was not at one time, nor by the sudden effect of a deluge, that the sea left uncovered those continents which we inhabit: it is certain, from the authority of Scripture, that the terrestrial Paradise was in Asia, and that Asia, was inhabited before the deluge; consequently, the waters, at that period, covered not this large portion of the globe. The earth, before the deluge, was nearly the same as now. This enormous quantity of water, poured out by Divine justice upon guilty men, destroyed every living creature; but it produced no change on the surface of the earth; it destroyed not even the plants; for the pigeon returned to the ark with an *olive branch* in her bill.

Why then should we suppose, with many naturalists, that the waters of the deluge totally changed the surface of the globe, even to the depth of two thousand feet? Why imagine that the deluge transported those shells, which are found at the depth of seven or eight hundred feet, immersed in rocks and in marble? Why refer to this event the formation of hills and mountains? And how is it possible to imagine, that the waters of the deluge transported banks of shells of 100 leagues in length? I perceive not how they can persist in this opinion, unless they admit a double miracle, one to create water, and another to transport shells. But as the first only is supported by Holy Writ, I see no reason for making the second an article of faith.

On the other hand, if the waters of the deluge had retired suddenly, they would have carried off such immense quantities of mud and soil, as would have rendered the land unfit for culture till many ages after this inundation. In the inundation which happened in Greece, the country that was covered remained barren for three centuries, (vide Acta Erudit. Lips. 1691, p. 100.) Thus the deluge ought to be regarded as a supernatural mode of chastising the wickedness of men, not as an effect proceeding from any natural cause. The universal deluge was a miracle, both in its cause and effects. It appears from the sacred text, that the sole design of the deluge was the destruction of men and other animals, and that it changed not in any manner the surface of the earth; for, after the retreat of the waters, the mountains, and even the trees, kept their former stations, and the land was suited for the culture of vines and other fruits of the earth. It might be asked, if the earth was dissolved in the waters, or, if the waters were so much agitated as to transport the shells of India into Europe, how the fishes, which entered not into the ark, were preserved?

The notion, that the shells were transported and left upon the land by the deluge, is the general opinion, or rather superstition, of naturalists. Woodward, Scheutzer, and others, call petrified shells the remains of the deluge; they regard them as medals or monuments left us by God of this dreadful catastrophe, that the memorial of it might never be effaced among men. Lastly, they have embraced this hypothesis with so blind a veneration, that their only anxiety is to reconcile it with Holy Writ; and, in place of deriving any light from observation and experience, they wrap themselves up in the dark clouds of physical theology, the obscurity and littleness of which derogate from the simplicity and dignity of religion, and present to the sceptic nothing but a ridiculous medley of human conceits and divine truths. To attempt an explanation of the universal deluge and of its physical causes; to pretend to give a detail of what passed during this great revolution; to conjecture what effects have resulted from it; to add facts to the Sacred Writings, and to draw consequences from these interpolations; is not this a presumptuous desire of scanning the power of the Almighty? The natural wonders wrought by his beneficent hand, in a uniform and regular manner, are altogether incomprehensible; his extraordinary operations, or his miracles, ought, therefore, to impress us with an awful astonishment, and a silent respect.

It may still be urged, that, as the universal deluge is an established fact, is it not lawful to reason upon its consequences? True. But you must commence with acknowledging, that the deluge could not possibly be the effect of any physical cause; you must regard it as an immediate operation of the Deity; you must content yourself with what is recorded in Scripture; and you must, above all, avoid blending bad philosophy with the purity of Divine Truth. After taking these precautions, which a respect for the counsels of the Almighty requires, what remains for examination upon the subject of the deluge? Does the Sacred Writings tell us that the mountains were formed by the deluge? They tell us the reverse. Do they inform us that the agitation of the waters was so great, as to raise the shells from the bottom of the ocean, and to disperse them over the face of the earth? No: The ark moved gently on the surface of the waters. Do they tell us, that the earth suffered a total dissolution? By no means. The narration of the sacred historian is simple and true; that of naturalists is complicated and fabulous.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE VI.

Geography.

THE surface of the earth is not, like that of Jupiter, divided into alternate bands or belts, parallel to the equator. On the contrary, it is divided, from one pole to the other, into two belts of earth, and two of sea. The first and principal belt is the ancient Continent, the greatest length of which is a line commencing at the most eastern point of the north of Tartary, and extending from thence to the neighbourhood of the gulf of Linchidolin, where the Russians fish for whales; from thence to Tobolski; from Tobolski to the Caspian Sea; from the Caspian Sea to Mecca; from Mecca to the western part of the country inhabited by the Galli in Africa; from thence to Monoemuci, or Monomotapa; and, lastly, to the Cape of Good Hope. This line is about 3600 leagues in length, and is never interrupted but by the Caspian and the Red Seas, the breadth of which is inconsiderable, and ought not to be regarded, especially as, like our seasons, the whole surface of the globe is divided into four parts only.

This greatest length of the Old Continent lies in a diagonal line; for, if measured by a meridian, it will appear, that, from the northernmost point of Lapland to the Cape of Good Hope, exceeds not 2500 leagues; and that this line, though shorter, meets with greater interruptions from the Baltic and Mediterranean. With regard to all other lines which could be drawn under the same meridians in the Old Continent, they must still be shorter than those we have mentioned. For example, from the most southern point of the Island of Ceylon to the northernmost coast of Nova Zembla, is 1800 leagues. In the same manner, if the Continent be measured by lines parallel to the equator, its greatest length, without much interruption by seas, will stretch from Trefana, on the west coast of Africa, to Ninpo, on the east of China, which is about 2800 leagues. Another line may begin near Brest, and extend to the coast of Chinese Tartary, which will be nearly 2300 leagues. From Bergen in Norway, to the coast of Kamschatka, is only 1800 leagues. All these lines are much shorter than the first. Hence the greatest length of the Old Continent extends from the eastern point of Tartary to the Cape of Good Hope, and is about 3600 leagues.

This line may be considered as the middle of the ancient Continent: for, in measuring the surface on each side of it, I find, that, on the left, there are 2471092$\frac{3}{4}$ square leagues; and, on the right, there are 2469687, which is an equality so astonishing, as to render it extremely probable that this line, which is the longest, at the same time really divides the contents of the ancient Continent.

Hence the Old Continent consists of about 4940780 square leagues, which is a fifth part of the surface of the globe, and may be regarded as a large belt of earth, with an inclination to the equator of about 30 degrees.

The New Continent is another belt of earth, the greatest length of which may be taken from the mouth of the river Plata to the lake of the Assiniboils. This line passes from the mouth of the river Plata to Lake Caracara; from thence to Mataguais, Pocona, Zongo, Mariana, Morua, St. Fé, and Carthagena; then it passes through the gulf of Mexico to Jamaica and Cuba; from thence along the peninsula of Florida, through Apalache, Chicachas; and from thence to St. Louis, Fort le Sueur, and terminates in the country bordering on Lake Assiniboils, the extent of which is unknown.

This line is interrupted only by the Gulf of Mexico, which may be considered as a Mediterranean Sea,) is about 2500 leagues in length, and divides the New Continent nearly into two equal parts, that on the left containing 1069286$\frac{5}{6}$ leagues square, and that on the right 1070926$\frac{1}{12}$. It is the middle of the belt of land called the New Continent, and is likewise inclined to the equator about 30 degrees, but in an opposite direction; for that of the Old Continent extends from the north-east to the south-west; but that of the New Continent from north-west to south-east. The superficial contents of the Old and New Continents are about 7080993 square leagues, not near a third part of the surface of the globe, which contains 25,000,000 square leagues.

Of these lines, which divide the Continents into two equal parts, it may be remarked, that they both terminate at the same degrees of north and south latitude; and that the two Continents make mutual advances, or projections, exactly opposite to each other, namely, those

on the African coast, from the Canary Isles to Guinea; and those of America, from Guiana to the mouth of the Rio Janeiro.

It is therefore apparent, that the most ancient lands on the globe are those which extend from 200 to 250 leagues on each side of the two lines above described. Agreeable to this idea, which is founded on the observations already made, we find that, in the Old Continent, the most ancient countries of Africa are those which stretch from the Cape of Good Hope to the Red Sea and Egypt, and are about 500 leagues broad: and, consequently, that the whole western coast of Africa, from Guinea to the Straits of Gibraltar, are new lands. In the same manner, if we trace this line through Asia, and include an equal breadth, we shall find, that the most ancient countries are, the two Arabias, Persia, Georgia, Turcomania, a part of Independent Tartary, Circassia, part of Muscovy, &c.; and, of course, that Europe, and perhaps also China, and the eastern part of Tartary, are comparatively new countries.

In the New Continent, we shall likewise find, that Terra Magellanica, the eastern part of Brasil, of the country of the Amazons, of Guiana, and of Canada, are new lands, when compared with Tucuman, Peru, Terra Firma, the islands in the Gulf of Mexico, Florida, the Mississippi, and Mexico. To these observations may be added two remarkable facts. The Old and New Continents are nearly opposite to each other. The Old Continent extends farther north of the equator than south; but the New, farther south than north. The centre of the Old Continent lies in the 16th or 18th degree of north latitude; and the centre of the New Continent lies in the 16th or 18th degree of south latitude, as if they were intended to counterbalance each other. There is another singular analogy between the two Continents, though it appears to be chiefly the effect of accident. Both Continents might be divided into two portions, which would be surrounded on all sides by the sea, except the two small isthmuses of Suez and Panama.

These general observations on the division of the globe are the result of an attentive survey. We shall not, upon this foundation, erect hypotheses, or indulge in reasonings, which might lead to false conclusions. But, as the division of the globe has not hitherto been considered under this point of view, I shall hazard a few remarks. It is not a little singular, that the longest line which can be drawn upon the two Continents should, at the same time, divide them into two equal parts. It is not less remarkable, that these two lines should commence and terminate at the same degrees of latitude, and have the same inclination to the equator. These relations may lead to general conclusions, of which we are still ignorant. We shall afterwards examine, in detail, the inequalities in the figure of the two Continents, and shall here only remark, that the most ancient countries should be found in the neighbourhood of the above lines, and should, at the same time, have the highest elevation; and that the more recent lands should be most remote from these lines, and likewise lie lower. Agreeably to this idea, the newest countries in America should be the land of the Amazons, Guiana, and Canada. In examining the map of these countries, we perceive that they are every where divided by numberless lakes and rivers, which is a still stronger indication of their recent origin. On the other hand, the regions of Tucuman, Peru, and Mexico, are high mountains, and situated near the line that divides the continent; circumstances which seem to prove the superior antiquity of these countries. Africa is also extremely mountainous, and at the same time very ancient. In this part of the globe, Egypt, Barbary, and the western coast, as far as Senegal, can only be considered as new lands. Asia is perhaps the most ancient of all countries, especially Arabia, Persia, and Tartary. But the inequalities of this great division of the globe, as well as those of Europe, shall be treated of in a separate article. We shall only remark, in general, that Europe is a new country, as appears from those universal traditions concerning migrations of different nations, and the origin of arts and sciences. It is not long since Europe was full of marshes and forests. But, in countries anciently inhabited, there are few woods, lakes, or marshes, but a great deal of heath and shrubs, and many high mountains, with dry and barren tops; for men destroy woods, drain marshes and lakes, and, in process of time, give an apppearance to the face of the earth totally different from that of uninhabited or newly peopled countries.

A small portion of the globe only was known to the ancients. The whole of America, the Arctic Circle, Terra Australis and Magellanica, and a great part of the interior regions of Africa, were unknown to them. They knew not that the Torrid Zone was inhabited, although they had sailed round Africa. About 2200 years ago, Necho, King of Egypt, furnished some vessels to the Phœnicians, who sailed down the Red Sea, doubled the Cape of Good Hope, and the third year after their departure they entered the Mediterranean by the Straits of Gibraltar, (see Herodotus, lib. 4.) The ancients, notwithstanding, were totally ignorant of the polarity of the loadstone, although they knew its power of attracting iron; they knew not the cause of the tides; and they were uncertain whether the ocean surrounded the globe. Some of them, indeed, suspected that it might be so; but these conjectures were so ill founded, that none of them ever dreamed of its being possible to circumnavigate the earth. Magellan, in 1519, was the first who attempted this great voyage; and he accomplished it in 1124 days. Francis Drake, in 1577, was the se-

cond; and he performed it in 1056 days. Thomas Cavendish set out upon this voyage in 1586, and finished it in 777 days.

These celebrated navigators were the first who gave a physical demonstration of the sphericity and extent of the circumference of the earth. The ancients, though they travelled much, had no adequate idea of the extent of the globe. They were equally ignorant of the trade-winds, which are so useful in long voyages. Their limited knowledge in geography, therefore, should not surprise us, especially when it is considered, that, notwithstanding the advantages derived from the mathematical sciences, and from the discoveries of navigators, many points remain still undetermined, and vast regions are yet undiscovered. Of the countries in the neighbourhood of the south pole, we only know that they exist, and that they are separated from the other continents by the ocean. [Captain Cooke, in his late voyage, has demonstrated, in the completest manner, that no continent exists near the south pole.] Much likewise remains to be discovered concerning the lands near the north pole: and, it is a subject of regret, that, for a century past, the ardour for discovering new countries has greatly abated. The nations of Europe seem, and perhaps they are right, more disposed to increase the value of those countries they have already discovered, than to acquire new territories.

The discovery, however, of the Southern Continent, would be a grand object of curiosity, and might be attended with the greatest advantages. A few of its coasts have been recognised; but those navigators who have attempted this discovery, have always been prevented from reaching land by large bodies of ice. The thick fogs which infest those seas form another obstacle. But, notwithstanding all these inconveniences, it is probable, that, by setting out from the Cape of Good Hope at different seasons, part of this new world might still be discovered.

Another method might, perhaps, be attended with more success. To avoid the fogs and the ice, the discovery might be attempted, by departing from Baldivia, or some other port on the coast of Chili, and traversing the South Sea under the 50th degree of south latitude. This navigation appears not to be hazardous; and it is probable that it would be attended with the discovery of new lands; for the regions about the south pole, still unknown, are so extensive, that they may be computed to be about a fourth part of the globe; and, consequently, may contain a country as large as the whole of Europe, Asia, and Africa.

While we remain ignorant of this part of the earth, we cannot determine the proportion the surface of the land bears to that of the ocean; from what we do know, it appears that there is more sea than land.

To acquire an idea of the vast quantity of water in the ocean, we must suppose a medium depth, for example, that of 200 fathoms, or the sixth part of a league. Upon this supposition, there is as much water in the ocean as would be sufficient to cover the whole globe to the depth of 600 feet; or, if collected into one mass, it would form a globe of 60 leagues in diameter.

It is alledged by navigators, that the latitudes near the south pole are much colder than the same latitudes towards the north. But this opinion seems to have no foundation. It appears to have been adopted from the circumstance of ice appearing in latitudes where none is found in the northern seas. But this effect may be owing to some peculiar causes. After the month of April there is no ice on this side of 67 or 68 degrees of north latitude; and the savages of Acadia and of Canada say, that, if the ice be not melted in April, it indicates a cold and rainy summer. The year 1725 was distinguished by an almost perpetual rain; and, in April, the ice in the northern seas was not only not melted at the 67th degree, but, on the 15th of June, it was found in lat. 41 or 42, (see l'Hist. de l'Acad. année 1725.)

Great quantities of floating ice appear in the north seas, especially at considerable distances from land. They come from the Tartarean Sea into that of Nova Zembla and other parts of the Frozen Ocean. I have been assured, by people worthy of credit, that an English Captain, called Manson, instead of searching for a passage to China between the northern lands, directed his course straight to the pole till he arrived within two degrees of it; and that, in this course, he found an open sea, and no ice; which is a clear proof that the ice is always formed near the land, and never in an extensive sea: for though it should be supposed, contrary to probability, that the cold was so intense at the pole as to freeze the surface of the sea, it is still inconceivable how these enormous floating masses could be formed, without being attached to the land, from which they are again separated by the heat of the sun. Two vessels sent by the East India Company, in 1739, to discover land in the South Seas, found boards of ice in latitude 47 or 48; but they were not very distant from the shore, which was in view, though the vessels could not make their landing good, [see on this subject a chart by M. Buache, 1739.] These boards of ice must have been detached from the lands in the neighbourhood of the south pole; and it may be conjectured that they follow the course of some large rivers in these unknown regions, in the same manner as the Oby, the Jenisca, and other great rivers that fall into the north seas, carry down boards of ice, which shut up, during the greatest part of the year, the straits of Waigat, and render the sea of Tartary, by this course, altogether inaccessible; while, beyond Nova Zembla, and nearer the pole, where there is little land and few rivers, boards of ice are less frequent, and the sea is more navigable. Hence, if any farther attempts

be made to find a passage to China and Japan by the north seas, it will, perhaps, be necessary to keep at a distance from the land and the ice, to steer directly towards the pole, and to explore the most open seas, where unquestionably there is little or no ice: for it is well known, that salt water can take on a greater degree of cold, without freezing, than fresh water after it is congealed; consequently, the excessive cold at the pole may render the sea colder than ice, without freezing its surface. Besides, at 80 or 82 degrees, the sea, though mixed with snow and fresh water, is never frozen, except near the coasts. From the united testimony of several navigators, it is apparent, that there is a passage from Europe to China by the north sea: the reason why it has so often been in vain attempted is obvious. Fear prevented the undertakers from keeping at a sufficient distance from the land, and from approaching the pole, which they probably imagined to be an immense rock.

William Barents, however, who, like many others, had run aground in his voyage, never doubted the existence of such a passage, or that, if he had kept farther from land, he would have found an open sea without ice. The Russian navigators sent by the Czar to reconnoitre the north sea, relate, that Nova Zembla is not an island, but a part of Tartary, and that, to the north of it, there is a free and open sea. A Dutch voyager affirms, that whales are occasionally thrown upon the coasts of Corea and of Japan, with European harpoons sticking in their backs. Another Hollander alledges, that he had penetrated to the pole itself, and assures us, that it was as warm as at Amsterdam in summer. One Goulden, an Englishman, who had made above 30 voyages to Greenland, related to Charles II. that two Dutchmen, who sailed along with him, having been unsuccessful in fishing off the coast of the Isle of Edges, resolved to proceed northward; that, upon their return, fifteen days after, they told him, that they had been at the 89th degree of latitude, where they found no ice, but an open, deep sea, like that in the Bay of Biscay; and that they showed him the two ships' journals in support of what they advanced. In fine, it is related in the Philosophical Transactions, that two navigators, who engaged in the discovery of this passage, penetrated 300 leagues to the east of Nova Zembla; but, on their arrival, the East India Company, who thought they had an interest in preventing the discovery, allowed them not to return that way to Europe. (See Collect. of Voyages to the North, p. 200.) But the Dutch East India Company, who believed themselves interested in the discovery, having made unsuccessful attempts on the European side, tried to find it by the way of Japan; and they would probably have succeeded, if the emperor of China had not prohibited all strangers from navigating on the coasts of the lands of Jesso. This passage, therefore, cannot be found but by steering directly to the pole beyond Spitzbergen, or rather by keeping the open sea between Nova Zembla and Spitzbergen, under the 79th degree of latitude. For the reasons already given, there is no occasion to dread ice, even under the pole itself; for there is no example of a large sea freezing at a great distance from land. The only sea that freezes totally is the Black Sea, which is narrow, contains little salt, and receives from the northern countries a number of rivers, and large boards of ice. If we may credit historians, this sea, in the time of the emperor Copronymus, froze to the depth of 30 cubits. This may be an exaggeration: but that it freezes every winter is certain, while open seas, 1000 leagues nearer the pole, never do. This fact can only be explained by the superior saltness, and the comparatively small quantity of ice-boards which these seas receive.

Boards of ice, which have been regarded as invincible obstacles to navigation near the poles, prove only the existence of large rivers in the neighbourhood of the places where they appear. They also demonstrate the existence of vast continents, from which these rivers derive their sources; and, therefore, we ought not to be discouraged by their appearance: besides, very little reflection will convince us, that these boards of ice must be confined to particular places; that it is impossible they should occupy the whole circle in which the southern continent is supposed to be contained; and, therefore, if a different route were taken, we have reason to hope for success. From the description of New Holland, given by Dampier, and others, it is probable, that this part of Terra Australis, which is, perhaps, a part of the southern continent, is a country less ancient than what remains to be discovered. New Holland lies low; it has neither mountains nor rivers; it is thinly inhabited, and the natives have no industry. All these circumstances induce us to think, that the savages of New Holland are similar to those of the Amazons, and of Paraguay, in America. In Peru and Mexico, which are the most elevated, and, of course, the most ancient countries of America, the manners of the inhabitants were polished; and they were divided into distinct nations, governed by sovereigns and by laws. Savages, on the contrary, are always found in low and new countries. Hence we may presume, that, in the elevated and interior parts of the southern continent, from which issue those large rivers that carry down boards of ice to the sea, there are men united by the bonds of society.

The interior parts of Africa are nearly as little known to us as they were to the ancients. They had circumnavigated this immense peninsula; but they have neither left us charts nor descriptions of its coasts. Pliny tells us, that this voyage was performed in the days of Alexander the Great; that the wrecks of some Spanish ships were found in the Arabian sea; and that Hanno,

the Carthaginian general, had sailed from Gades to the Arabian gulf, and had written a relation of the voyage. He farther informs us, that, in the days of Cornelius Nepos, one Eudoxus, who had been persecuted by king Lathurus, was obliged to fly; that he departed from the Arabic gulf, and arrived at Gades; and that, previous to this period, Spain carried on a trade by sea with Æthiopia. (See Plin. Hist. Nat. tom. i. lib. 2.) But, notwithstanding these testimonies, we are of opinion, that the ancients never doubled the Cape of Good Hope: every man considered the voyage of the Portuguese to the East Indies as a new discovery. It will not be incurious to see the sentiments entertained of this subject in the ninth century. 'In our days, a discovery has been 'made which was totally unknown to those who lived 'before us. No man believed, or could suspect, that 'the sea which reaches from the Indies to China, had 'any communication with the sea of Syria. But we 'have lately found, according to my information, in the 'Mediterranean, or sea of *Roum*, the wreck of an Arabian ship which had been staved to pieces by a tempest. 'Some of these pieces had been carried, by the wind and 'the waves, into the sea of the Cozars; from thence 'round to the Mediterranean, and along that sea to the 'coast of Syria. This is a demonstration that the ocean 'surrounds China and Cila, the extremity of Turqueston, 'and the country of the Cozars, and that, at last, it 'enters by the Straits, and washes the borders of Syria. 'The evidence arises from the construction of the vessel; 'for there are no ships but those of Siraf whose planks 'are not nailed. But the vessel above mentioned had 'all her planks stitched together in a manner peculiar to 'the Arabians. But all vessels belonging to the Mediterranean, and the coast of Syria, have their timbers 'fastened with nails.' (See Les Anciennes Relationes de Voyages faits par Terre à la Chine, p. 53.)

I shall subjoin the remarks added by the translator of this ancient relation.

'Abuziel remarks, as a thing perfectly new, that a 'vessel had been carried from the Indian Sea, and 'thrown upon the coast of Syria. To find a passage 'for it into the Mediterranean, he supposes, that there 'is a great extent of sea beyond China, which communicates with the sea of the Cozars, or of Muscovia. 'The sea beyond Cape Current was entirely unknown 'to the Arabians, on account of the extreme hazard of 'navigating it, and because the continent was inhabited 'by a people so barbarous, that it was impossible either 'to conquer them, or to civilize them by commerce. 'The Portuguese found not, from the Cape of Good 'Hope to Soffala, any Moors who had an established 'settlement, like those in all the maritime villages as far 'as China, which was the farthest place known to geographers. But they could not tell whether the Chinese 'sea communicated with that of Barbary by the extremity of Africa; they only described it to the coast of 'Zinga or Caffraria. We cannot, therefore, hesitate in 'pronouncing, that the first discovery of the passage of 'this sea, by the Cape of Good Hope, was made by the 'Europeans, under the command of Vasca de Gama, or, 'at least, a few years before he doubled that Cape, if we 'may credit some sea charts of an older date, where the 'Cape is marked under the name of *Fronteira da Africa*. 'Antony Galvan relates, upon the testimony of Francisco 'de Sousa Tavares, that in 1528, the infant Don Ferdinand shewed him a similar chart from the monastery of 'Acoboca, dated 120 years before, copied, perhaps, from 'that said to be in the treasury of St. Marc at Venice, 'on which the point of Africa is likewise delineated, 'according to the evidence of Ramusio,' &c.

The ignorance of these ages concerning the navigation round Africa is not, perhaps, so singular as the silence of the editor of this ancient relation with regard to the passages in Herodotus, Pliny, &c. which we have quoted, and which proved that the ancients had sailed round Africa.

However this matter stands, the coasts of Africa are now well known. But all the attempts which have been made to penetrate into the interior parts, have not furnished us with exact accounts. It would be a great object to go far up the country, by means of the Senegal, or some other great river, and establish settlements. According to every appearance, we should there find a country as rich in precious metals as Peru or Brazil. It is well known, that the rivers of Africa abound in gold dust; and, as the country is very high and mountainous, and is, besides, situated under the equator, it unquestionably contains, as well as America, mines of the heaviest metals, and stones of the hardest and most compact texture.

The vast extent of North and East Tartary is but a late discovery. If the Russian charts be just, we know the whole coast of this part of Asia; and it appears, that, from the termination of East Tartary to North America, it is an extent not above 400 or 500 leagues. It has even been lately reduced to a much shorter space. In the Amsterdam Gazette of 24th January, 1747, under the article Petersburgh, it is alledged, that M. Stolleravoit had discovered, beyond Kamtschatka, one of the North American isles, and that he had demonstrated that we might sail from Russia to America by a very short passage. The Jesuits and other missionaries also pretended to have known savages in Tartary, whom they had catechized in America, which supposes the passage to be indeed very short. (See Charlevoix, tom. iii. p. 30.) Charlevoix would have us believe, that the old and new continents are united in the northern parts. He says, that some late voyages of the Japanese make it

probable that the passage we have been mentioning is only a bay, beyond which we may pass, by land, from Asia to America. But this notion requires confirmation; for it has always been thought, that the continent of the North Pole is probably separated from all other continents, as well as that of the South Pole.

Astronomy and navigation have reached so high a pitch of perfection, that we may reasonably hope soon to have an exact knowledge of the whole surface of the globe. The ancients, who were ignorant of the mariner's compass, were able to discover a small part of it only. Some pretend that the Arabians invented this instrument, and that, by means of it they carried on trade with India as far as China, (see l'Abregé de l'Hist. des Sarazins de Bergeron, p. 119.) But this notion has always appeared to me to be destitute of foundation; for there is not in the Arabian, Turkish, or Persian languages, a word that signifies a mariner's compass: they use the Italian word *bossola*. Even at this moment, they can neither make compasses nor give polarity to the needle. They purchase these articles from the Europeans. Father Martini alledges, that the Chinese have been acquainted with the compass these 3,000 years, (see Hist. Sinica, p. 106.) If these facts be true, how should it happen that they have made so little use of this instrument? Why, in their voyage to Cochinchina, did they take a longer course than was necessary? Why did they always limit themselves to the same expeditions, the longest of which was to Java and Sumatra? And why did they not discover, before the Europeans, a vast variety of islands and fertile countries in their own neighbourhood, if they possessed the art of navigating in the open seas? It was but a few years after the discovery of this wonderful quality of the loadstone, that the Portuguese doubled the Cape of Good Hope, and traversed the African and Indian Oceans, and that Christopher Columbus sailed to America.

It was not difficult to conjecture, that immense regions existed in the western part of the globe; for on computing what was known of it, namely, the distance from Spain to China, and attending to the revolution of the earth, or of the heavens, it was easy to perceive, that a greater extent lay to the west than what had been already discovered on the east. That the ancients found not the new world, was not owing to a deficiency in astronomical science, but solely to their ignorance of the compass. The passages of Plato and of Aristotle, which mention countries far beyond the Pillars of Hercules, seem to indicate that some mariners had been driven by a tempest on the coast of America, from which they had returned with infinite labour. But, supposing the ancients to have been thoroughly convinced, from the relations of voyagers, that such a continent existed, being ignorant of the compass, they could not possibly derive any advantage from such conviction.

I acknowledge, that it is not absolutely impossible for resolute men, with no other guide than the stars, to sail in open seas. The ancients were in possession of the Astrolabe. They might take their departure from France or Spain, and sail to the west by always keeping the polar star on their right hand; and, by frequent soundings, they might keep nearly in the same latitude. It was unquestionably by keeping the pole-star on their left, that the Carthaginians mentioned by Aristotle were enabled to return from those distant regions. But it will still be allowed, that a voyage of this kind must have been regarded as a rash and hazardous enterprize. We ought not, therefore, to be surprized, that the ancients never conceived such project.

Before the expedition of Columbus, the Azores, the Canaries, and Madeira, had been discovered. It had been remarked, that, when the west winds continued long to blow, the sea threw upon the coasts of these islands pieces of strange wood, canes of an unknown species, and even dead bodies, which, by several marks, were known to be neither Europeans nor Africans, (see Charlevoix, tom. i. p. 66.)

Columbus himself remarked, that, on the west coasts, certain winds blew for some days, which he was persuaded proceeded from land. But, though he possessed all these advantages over the ancients, and likewise the compass, the difficulties to be encountered were so great, that nothing less than success could have justified the enterprize. Suppose, for a moment, that the continent of America had been 1,000 or 1,500 leagues more distant, a circumstance which Columbus could not foresee, he never would have arrived, and perhaps this vast country might still have remained undiscovered. This conjecture receives additional force, when it is considered, that Columbus, though the ablest navigator of his age, was seized with terror and astonishment in his second voyage to the New World. As, in his first voyage, he found nothing but islands, he directed his course more to the south in quest of a continent; but found himself stopped by currents, the great extent of which, and their uniform opposition to his course, obliged him to direct his search more to the west. He imagined, that it was not currents which prevented him from advancing to the south, but that the sea was rising to the heavens, and that both perhaps touched each other in the southern parts. Thus, in great undertakings, the most trifling difficulty may sometimes turn a man's brain, and extinguish his courage

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE VII.

Of the Formation of Strata, or Beds, in the Earth.

WE have demonstrated, in the first article, that the earth, in consequence of the mutual attraction between the particles of matter, and of the centrifugal force that results from its diurnal revolution, must have assumed the figure of a spheroid, the two diameters of which differ about a 230th part; and that nothing but the changes made on the earth's surface, by the motions of the air and the waters, could augment this difference, in the manner alledged by those who measured a degree under the equator, and another within the polar circle. This figure of the earth, which agrees so well with the laws of hydrostatics and with our theory, indicates that, at the time it assumed its figure, it was in a state of fluidity. We have also proved, that the projectile motion, and the motion of rotation, were impressed at the same time, and by the same impulse. It will more readily be admitted, that the earth was originally in a state of liquifaction, when it is considered, that the greatest part of the materials of which this globe is composed are either vitrifactions, or vitrifiable by fire. The impossibility of rendering the earth fluid by the operation of waters confirms this hypothesis; because there is infinitely more earth than water, and the water is not able to dissolve sand, rocks, and hard minerals.

It is, therefore, evident, that the earth assumed its figure when in a fluid state. And, to pursue our theory, it is natural to think, that the earth, when it issued from the sun, had no other form but that of a torrent of melted and inflamed matter; that this torrent, by the mutual attraction of its parts, assumed a globular figure, which its diurnal motion changed into a spheroid; that, when the earth cooled, the vapours which were expanded like the tail of a comet, gradually condensed, fell down in the form of water upon the surface, depositing, at the same time, a slimy substance, mixed with sulphur and salts, part of which was carried, by the motion of the waters, into the perpendicular fissures of the strata, and produced metals, and the rest remained on the surface, and gave rise to the vegetable mould, which abounds, in different places, with more or less of animal and vegetable particles, whose organization is not obvious to the senses.

Thus the interior parts of the globe were originally composed of vitrified matter; and, I believe, they continue so at present. Above this vitrified matter were placed those bodies which the fire had reduced into the smallest particles, as sands, which are only portions of glass; and, above these, pumice stones, and the scoriæ of melted matter, which gave rise to the different clays. The whole was covered with water to the depth of 500 or 600 feet, which originated from the condensation of the vapours, when the earth began to cool. This water deposited a stratum of mud, mixed with all those matters that are capable of being sublimed or exhaled by fire; and the air was formed of the most subtile vapours, which, from their levity, rose above the water. [This opinion, that the earth was entirely covered with water, corresponds with the sentiments of several ancient philosophers, and likewise with those of many of the fathers of the church. In mundi primordio, aqua in omnem terram stagnabat, says St. John of Damascus, lib. ii. cap. 9. Terra erat invisibilis, quia exundabat aqua et operiebat terram; St. Ambrose, lib. i. cap. 8. Submersa tellus cum esset, faciem ejus, inundante aqua, non erat adspectabilis; St. Basile, Hom. 2. See likewise St. Augustine, lib. i. cap. 12.]

Such was the condition of the earth, when the tides, the winds, and the heat of the sun, began to introduce changes on its surface. The diurnal motion of the earth, and that of the tides elevated the waters in the equatorial regions, and necessarily transported thither great quantities of slime, clay, and sand, and, by thus elevating these parts of the earth, they perhaps sank those under the poles about two leagues, as was formerly remarked: for the waters would easily reduce into powder pumice-stones, and other spungy parts of the vitrified matter upon the surface, and by this means, excavate some places, and elevate others, which, in time, would produce islands and continents, and all those inequalities on the surface, that are more considerable towards the equator than the poles. The highest mountains lie between the Tropics and the middle of the Temperate Zones, and the lowest from the polar circles towards the poles. Between the Tropics are the Cordeliers, most of the mountains of Mexico and the Brazils, the great and lesser Atlas, the mountains of the Moon, &c. Besides,

both the land and the sea have most inequalities between the tropics, as is evident from the incredible number of islands peculiar to these regions.

However independent of my general theory, this hypothesis, concerning the original state of the globe, may be I have chosen to refer to it in this article, with a view to show the connection and possibility of the system endeavoured to be established in the first article. It may only be remarked, that my theory is not opposed by the facts; that I take the earth nearly as it stands at present; and that I lay hold of none of those suppositions which are often used in reasoning concerning the former condition of the earth. But, as I here offer a new idea upon this subject of the sediments deposited by the waters that, in my opinion, gave rise to the upper stratum of the earth, it will not be improper to exhibit the reasons upon which it is founded.

The vapours exhaled from the earth produce rain, dews, thunder, lightning, and other meteors. These vapours, therefore, are mixed with particles of water, air, sulphur, earth, &c.; and it is the solid earthy particles which constitute the slime or mud under consideration. The purest rain-water deposits a quantity of this mud; and, when a quantity of dew is collected, and allowed to corrupt, it produces a greater proportional quantity of mud, which is fat, unctuous, and of a reddish colour.

The upper stratum of the earth is composed of this mud, mixed with particles of animal and vegetable substances, or rather with particles of stone and sand. It is worthy of remark, that most arable land is reddish, and more or less blended with heterogeneous matters. The particles of stone or of sand found in the upper stratum are of two kinds; the one is gross and heavy, the other fine, and sometimes impalpable. The gross is detached from the inferior stratum by labouring the ground; or, rather, the upper stratum, by penetrating the inferior, which is composed of sand and gravel, forms what is called *fat* or *fertile sand*. The finer species proceeds from the air, falls down with the dew or rain, and intimately incorporates with the vegetable mould, or upper stratum. This last is nothing more than the dust, transported by the air, and again deposited by rain or a moist atmosphere. When the quantity of this mud is great in proportion to the particles of stone or sand, the soil is red and fertile; if it be considerably mixed with animal and vegetable substances, it is blackish; but, if the quantity of mud and of vegetable and animal substances be small, the soil is white and barren; and even when the particles of sand, stone, or chalk, which compose these barren soils, are mixed with a considerable quantity of animal and vegetable substances, they become black and light, but have very little fertility. According, therefore, to the different proportions of these three ingredients, the soil is more or less fertile, and differently coloured.

In order to acquire distinct ideas concerning the strata of the earth, we shall take for an example the pits at Marly la Ville, which are extremely deep. This place is situated in a high, but flat and fertile country, and its strata lie horizontally. I procured specimens of all these strata in their order from M. Dalibard, an eminent botanist, and a man of science; and, after having proved, with aqua fortis, the nature of the matters they respectively consist of, I arranged them in the following table.

Table of the different beds of earth at Marly-la-Ville, to the depth of 100 *feet.*

	Feet.	Inch.
1. A free reddish earth, mixed with a large quantity of mud, a little vitrifiable sand, and a greater proportion of calcinable sand, or gravel	13	
2. A free earth mixed with gravel and with more vitrifiable sand	2	6
3. Mud mixed with a large quantity of vitrifiable sand, which made but a small effervescence with aqua fortis	3	
4. Hard marl, which effervesced violently with aqua fortis	2	
5. A marly stone very hard	4	
6. Marl in powder, mixed with vitrifiable sand	5	
7. Fine vitrifiable sand	1	6
8. Marl, resembling earth, mixed with a little vitrifiable sand	3	6
9. Hard marl, in which was found genuine flint	3	6
10. Gravel, or marl in powder	1	
11. Eglantine, a hard ringing stone, of the grain of marble	1	6
12. Marly gravel	1	6
13. Marl, in the form of hard stone, with a fine grain	1	6
14. Marl, like stone, with a coarser grain	1	6
15. Marl still more gross	2	6
16. Fine vitrifiable sand, mixed with fossil sea-shells, which had no cohesion with the sand, and which still preserve their natural colours	1	6
17. Fine gravel, or marl-dust	2	
18. Marl in the form of a hard stone	3	6
19. Marl in the form of coarse powder	1	6
20. Hard stone, calcinable like marble	1	
21. A gray vitrifiable sand, mixed with fossil shells, particularly with oysters and spondyles, which had no cohesion with the sand, and were not petrified	3	
22. A white vitrifiable sand, mixed with the same shells	2	
23. A vitrifiable sand, with red and white streaks, and mixed with the same shells	1	
Carried over	63	

	Feet.	Inch.
Brought over	63	
24. A coarser vitrifiable sand, mixed with the same shells	1	
25. A fine, gray, vitrifiable sand, mixed with the same shells	8	6
26. A fine unctuous sand, with very few shells	3	
27. Brown free stone	3	
28. Vitrifiable sand, striped with red and white	4	
29. A white vitrifiable sand	3	6
30. A reddish vitrifiable sand	15	
Total depth of the pit	101	

I formerly mentioned, that I had examined all these substances with aqua fortis, because no other test can enable us to make real distinctions between earthy bodies of the same or of different appearances. Those which effervesce and suddenly dissolve, on the application of the aqua fortis, are generally calcinable. Those, on the other hand, upon which that acid makes no impression, are vitrifiable.

From this enumeration of strata it is evident, that the land at Marly-la-Ville was formerly covered with the sea, to the depth of 75 feet, since shells are found 75 feet below the surface. Those shells have been collected and deposited by the water, together with the sand, which contains them; and the whole superior strata, except the uppermost, have been transported thither by the motion of the waters, and deposited in the form of sediment, as is apparent from their horizontal position, from the mixture of sand, shells, and marl, which last is composed of decayed shells; and even the upper stratum has been almost wholly formed of slime or mud, with a small mixture of marl.

I have chosen this example, because it is least favourable to my theory; for it appears, at first view, difficult to conceive how the mud deposited by the dew and rains should produce a bed of vegetable soil 13 feet thick. But it ought to be remarked, that a soil of this thickness is rarely to be found, especially in high countries. The general run of soils are from three to four feet, and often they exceed not one foot. The soil is thickest in plains surrounded with hills; because the rains daily bring fresh supplies from the higher grounds. But, abstracting from this supposition, it is plain, that the upper strata formed by the sea are thick beds of marl. It is natural to think, that the upper stratum was originally much thicker, and that beside the 13 feet, the sea would leave a considerable quantity of marl. But this marl, being exposed to the action of the air, of rains, and of the rays of the sun, would soon be reduced into a fine powder. The sea would not leave this land suddenly, but would continue for some time occasionally to cover it, either by the motion of the tides, or by extraordinary swells during great storms; and, of course, the upper stratum would be mixed with mud, clay, and other slimy bodies. After being entirely above the reach of the waves, plants would begin to grow, and the soil would constantly accumulate, and be tinged with a reddish colour by the mud deposited by dews and rain. Culture would still farther increase both its fertility and its thickness, and, by allowing the dews and rains to penetrate deeper, would, in process of time, produce this soil of 13 feet.

I shall not here examine, whether the reddish colour of vegetable mould proceeds from a quantity of iron contained in the mud deposited by rain and dews. This point, which is of some importance, shall be discussed when we come to treat of minerals. It is sufficient to have given a view of the manner in which the upper stratum has been formed: we shall now prove, by other examples, that the formation of the interior strata of the earth must likewise have originated from the operation of the waters.

The upper stratum of the globe, says Woodward, that magazine for the formation and support of animals and vegetables, is mostly composed of vegetable and animal matter, and is in perpetual fluctuation. All the animals and vegetables which have existed since the creation, have successively extracted from this stratum the materials of which their bodies are constructed; these they again restore at their dissolution, where they remain prepared for the successive formation of new bodies of the same species; the matter which forms one body being naturally disposed to make another of the same kind. (See Woodward's Essay, p. 136.) In uninhabited countries, where the woods are never cut, nor the herbs broused by cattle, the soil is constantly augmenting. The soil in all woods, even in those which are occasionally cut, is from 6 to 8 feet thick, and has originated from the leaves, and other decayed parts of vegetables. I have often remarked, that, upon an old Roman way which runs across Burgundy, the stones with which it was constructed are covered with a black mould of more than a foot thick, and that it nourishes trees of a considerable size. This soil could only be produced by the gradual and successive destruction of vegetable bodies. As vegetables derive more of their substance from the air and water than from the earth, when they decay, they add more to the soil than they extracted from it. Besides, forests collect and retain vapours and moisture; and, of course, in old woods, the soil is greatly augmented. But, as animals restore much less to the earth than they take from it; and, as men consume vast quantities of wood and herbs for fuel and other purposes, it follows, that the vegetable soil of populous countries must continually diminish, and become, in time, like those of Arabia Petrea and other eastern countries, which were

first inhabited, where nothing is now to be found but sand and salts; for the fixed salts of plants and of animals remain, while all the other parts volatilize, and are carried off by the air.

Let us next examine the position and formation of the interior strata. The earth, says Woodward, wherever it has been dug, is composed of beds or strata, one above another, in the same manner as if they had proceeded from successive sediments deposited by water. The beds which lie deepest are thicker than those immediately above them, and they are gradually thinner till they arrive at the surface. Sea-shells, teeth, and bones of fishes, are found in these beds, and not only in those which are soft, as chalk, clay, and marl, but even in beds of hard stone, marble. &c. These productions of the sea are incorporated with the stone. and, when separated, leave in the stone the figure of their surface exactly delineated. 'I was abundantly 'assured,' says this author, 'that the circumstances of 'these things in remoter countries were much the same 'with those of ours here: that the stone, and other 'terrestrial matter, in France, Flanders, Holland, Spain, 'Italy, Germany, Denmark, Norway, and Sweden, was 'distinguished into strata, or layers, as it is in England: 'that those strata were divided by parallel fissures: that 'there were inclosed in the stone, and all the other denser 'kinds of terrestrial matter, great numbers of shells, and 'other productions of the sea; in the same manner as 'in that of this island. To be short, by the same means 'I got sufficient intelligence that these things were 'found in like manner in Barbary, in Egypt, in Guinea, 'and other parts of Africa: in Arabia, Syria, Persia, 'Malabar, China, and other Asiatic provinces: in Ja-'maica, Barbadoes, Virginia, New England, Brazil, 'Peru, and other parts of America.' p. 6, 41, 42, &c.

Woodward gives no authority for his assertion, that shells are found in the strata of Peru. But as, in general, his facts are true, I doubt not but his information has been good; and I am persuaded that shells exist in the strata of Peru, as well as every where else. I make this remark on account of a doubt which has been entertained, and which shall afterwards be considered.

In digging a well at Amsterdam, 232 feet deep, the strata were arranged in the following order: 7 feet of vegetable soil, 9 feet of turf; 9 feet of soft clay; 8 feet of sand; 4 of earth; 10 of clay; 4 of earth; 10 of sand; 2 of clay; 4 of small white sand; 5 of dry earth; 1 of soft earth; 14 of sand; 8 of clay mixed with sand; 4 of sand mixed with shells; then 102 feet of clay; and, *lastly*, 31 feet of sand. (See Varenii Geograph. gen. p. 46.

It is uncommon to dig so deep before we find water: but this fact is remarkable in many other respects. 1st. It demonstrates that the sea communicates not with the interior parts of the earth by means of filtration: 2d. That shells are found 100 feet below the surface in a country extremely low; and, consequently, that the land of Holland has been elevated 100 feet by the sediments of the ocean: 3d. It may be concluded, that the bed of clay of 102 feet, and the bed of sand, 31 feet of which only had been dug, and whose actual thickness is unknown, lie near to the ancient and original earth that existed before the motion of the waters began to change its surface. In the first article, it was remarked, that, in order to discover the ancient earth, we must dig in the northern, rather than in the southern regions; and in the low and plain, rather than in the elevated countries. These circumstances nearly concurred in the present case. We only wish that the pit had been dug deeper, and that the author had informed us, whether shells, or other sea-bodies, were intermixed with the last strata of clay and of sand. This experiment confirms what was formerly advanced, that the strata are always thicker in proportion to their depth.

The earth consists of parallel and horizontal strata, not in the plains only, but, in general, the hills and mountains have the same structure. The strata of the mountains are even more conspicuous than those of the plains; for the plains are commonly covered with great quantities of sand and earth brought from the higher grounds by the waters; and, therefore, to find the ancient strata, we must dig deeper in the plains than in the mountains.

I have often remarked, that, when the top of a mountain is level, its strata are likewise level; but, when the top is not horizontal, the strata follow the direction of its declivity. It has frequently been alledged, that the beds of quarries incline to the east. But in all the chains of rocks which I have examined, I found, that these beds always follow the declivity of the hill, whether its direction be east, west, south, or north. In raising stones from the quarry, they are always separated according to their natural position; and, if cut in a contrary direction, it is impossible to raise them of any considerable size. In all good masonry, the workmen place the stones in the direction in which they lay in the quarry. If laid in an opposite position, they will split, and be unable to resist the weight of the incumbent building. Hence we may conclude, that stones have been originally formed in horizontal beds; that these beds have been successively accumulated above each other, and have been composed of materials, the resistance of which is stronger in that than in any other direction.

Every stratum, of whatever kind, whether it be horizontal or inclined, is of an equal thickness through its whole extent. In the quarries round Paris, the stratum of good stone is but about 18 or 20 inches thick throughout. In the quarries of Burgundy, the stone is much thicker. The same inequalities take place in marbles.

The white and black marbles are thicker than those that are coloured; and there is a hard stone with which the people of Burgundy cover their houses, that exceeds not an inch in thickness. Thus, different strata differ much with regard to thickness; but each stratum uniformly preserves the same thickness through its whole extent. This difference is so great, that strata are to be found, from less than a line, to 1, 10, 20, 30, and 100 feet thick. Both ancient and modern quarries, which are dug horizontally, the shafts of mines, and the working of lead, either longitudinally or transversely, prove that strata extend a great way on all sides. 'It is well 'known,' as the historian of the academy observes, 'that all stones have originally been a soft paste, and 'that, as stones are almost every where to be met with, 'the surface of the earth, in all these places, at least to 'a certain depth, must have consisted of mud and slime. 'The shells found in most quarries demonstrate, that 'this mud was an earth diluted by the water of the sea; 'and, consequently, that the sea once covered all these 'places; but the sea could not cover them, without, at 'the same time, covering all places that were lower, or 'on the same level. Now, it is impossible that the sea 'could cover all those places where there are quarries, 'without covering the whole surface of the globe. If 'the mountains were then formed, the sea must also 'have covered them; for they are full of rocks and quar-'ries, and shells are often found in them.

'The sea, then,' continues he, 'covered the whole 'earth; and hence all the beds of stone in the plains 'are horizontal and parallel: the fishes, therefore, were 'the most ancient inhabitants of the globe; for neither 'land-animals nor birds could exist. But how has the 'sea retired into those vast basons which it now occu-'pies? the most natural supposition is, that the earth, 'at least to a certain depth, was not all equally solid, 'but interspersed with vast vaults or caverns, the arches 'of which would remain for a time, and at last suddenly 'fall in. The waters would then rush into these hol-'lows, fill them up, and leave a part of the surface dry, 'which would become a convenient habitation for land-'animals and birds. The shells found in quarries 'strongly confirm this idea; for nothing but the bony 'parts of fishes could be preserved so long in the earth. 'Besides, shells commonly lie in vast masses in certain 'parts of the sea, where they remain immoveable, and 'form a species of rocks or banks; they could not, 'therefore, follow the sea, which suddenly abandoned 'them. It is for this last reason that we find such num-'bers of fossil-shells, and so few vestiges of other fishes, 'which is a farther proof that the waters retired with 'rapidity into their present basons. When the vaults 'sunk down, it is very probable that mountains were 'elevated by the same cause, and placed upon the sur-'face with rocks and quarries already formed. But the 'beds of these quarries could not preserve their original 'horizontal position, unless they were raised exactly 'perpendicular to the surface, which would rarely happen. 'Thus, as we formerly remarked, (see Mem. de l'Acad. 'ann. 1705. p. 30.) the beds of stone in mountains are 'all inclined to the horizon, though they be parallel to 'each other; for they changed not their position with 'regard to one another, but with regard only to the 'surface of the earth.' (Ibid. ann. 1716, p. 14.)

These parallel beds of earth or stone, which have been formed by sediments of the ocean, often extend to considerable distances. We even find, in hills separated by valleys, beds of the same materials upon equal levels. This observation has a perfect correspondence with the equal altitudes of opposite hills. The truth of this fact may be easily established; for, in all hills separated by narrow valleys, where stone or marble is found on one hill, we uniformly find these very substances, at the same level, on the opposite hill. I have traced a quarry of marble 12 leagues in length; its breadth is also considerable, though I have not been able to ascertain it with precision. I have often observed, that this bed of marble has every where the same thickness; and that, in hills separated by a valley of 100 feet deep, the same bed always appeared at the same altitude. I am firmly persuaded, that this observation holds with regard to all quarries of stone or of marble which contain shells; but it applies not to beds of freestone. We shall afterwards explain why freestone is not dispersed, like other matters, in horizontal beds, but in blocks, irregular both in form and position.

It has likewise been remarked, that, on the opposite sides of straits of the sea, the strata are the same. This observation is important, and may lead to the discovery of those necks of land, or islands, which have been separated from the Continent. It proves, for example, that England has been separated from France, Spain from Africa, and Sicily from Italy; and it is to be regretted, that the same observation has not been made upon all straits. I have no doubt but it will hold universally. We know not, whether, in the Straits of Magellan, the longest we are acquainted with, the same strata are to be found at the same latitude. But we perceive, from very exact charts, that the opposite coasts, which are high, have corresponding angles like those observable in our inland mountains; and this farther proves Terra del Fuego to have been formerly a part of the Continent of America. The same remark has been made with regard to the strait of Frobisher; and the island of Friesland appears to have been separated from the continent of Greenland.

The Maldivia islands are separated from each other by small branches of the sea; and, on each side of the opposite islands, the strata of rocks, &c. are the same. These islands, which, when taken together, extend about

200 leagues in length, were formerly one. They are divided into 13 provinces, called *Clusters*. Every Cluster contains a great number of small islands, most of which will soon be under water. It is remarkable, that each of these 13 Clusters is surrounded with a chain of rocks of the same stone, and that there are only three or four small and dangerous openings, through which each of them can be approached. They are all placed in a line, with their ends to each other, and appear evidently to have been once a long mountain crowned with rock, (see Voyag. de Franc. Pyrard, vol. i. p. 107.)

Several authors, as Verstegan, Twine, Sommer, but particularly Campbell, in his description of the county of Kent, give striking proofs that England was formerly joined to France, and that the neck of land that divides them had been carried off by the sea, which retired, and left a great quantity of low marshy ground along the southern coasts of England. As a farther proof of this fact, Dr. Wallis has attempted to show an affinity between the ancient language of the Gauls and that of the Britons; and he adds several other remarks, which shall be related in the following articles.

If travellers observed the figure of lands, the position of mountains, and the windings of rivers, they would perceive that opposite hills are not only composed of the same materials, at the same altitudes, but that they are also nearly of an equal height. In all the places where I have travelled, I uniformly remarked this equality in the height of opposite hills, especially when they are separated by valleys not above a fourth or a third of a league wide. In valleys of greater width, it is difficult to judge of the height or equality of hills: for, on looking over a level and extensive plain, it appears to rise; and distant hills seem to sink. But this is not the place to account for these phænomena. Besides, it is not easy to determine, by the eye, the middle of a large valley, unless it be traversed by a river. But, in narrow valleys, the judgment of the eye is more certain. That district of Burgundy comprehended between Auxerre, Dijon, Autun, and Bar-sur-Seine, of which a considerable portion is called *le Bailliage de la Montagne*, is one of the most elevated parts of France. From one side of these mountains, which are only of the second order, the water runs to the ocean, and from the other, to the Mediterranean. There are points of partition, as at Sombernon, Pouilli in Auxois, &c. where the water may be turned at pleasure, either to the ocean or the Mediterranean. This high country is intersected with a number of small valleys, and most of them are watered with rivulets. Here I have a thousand times observed the corresponding angles of the hills, and their equality as to height; and I can with confidence affirm, that the saliant or prominent angles are uniformly opposed to the concave ones, and that the heights of the two sides are nearly the same. The farther we advance in this high country, where are the points of partition mentioned above, the mountains rise the higher. But this height is always the same on the opposite sides of the valleys, and the hills rise or fall equally. The same observation I have repeatedly made in several other provinces of France; but they extend not to very high mountains; for these are more irregular as to height, and often terminate in unequal points or peaks. In frequently traversing the Alps and Appennines, I observed, that the angles, in effect, corresponded; but that it is almost impossible to judge, by the eye, concerning the equality or inequality in the heights of opposite mountains; because their tops are lost in the clouds.

The different strata composing the earth are not arranged according to their specific gravities. Beds of heavy matter are frequently placed above those of lighter. Solid rocks are often supported by beds of earth, clay, or sand, which are greatly inferior in specific gravity. This is the case with most hills, and is easily perceived. But, in high mountains, the summits are not only rocks, but these rocks are supported by others; and this structure runs through such an extent of country, where one mountain rises out of another, that it is difficult to determine whether they are founded on earth, or of what nature this earth is. I have seen rocks cut perpendicularly for some hundreds of feet; but these rocks rested upon other rocks, without my being able to perceive where they ended. May we not, however, be allowed to conclude from the less to the greater? Since the rocks of small mountains, the bases of which are visible, rest upon earths less heavy and less solid than stone, is it not reasonable to think, that earth is likewise the basis of high mountains? Besides, all I have here advanced tends to prove, that heavy bodies might be accumulated, by the motion of the waters, above light ones; and, if this really takes place in most hills, it is probable that it has happened in the manner pointed out by my theory. But, should it be objected, that I had no reason to suppose, that, prior to the formation of mountains, the heavier matter was below the lighter; I answer, that I affirm nothing with regard to this article; because there are many ways by which this effect might be produced, whether the heavy matter was above or below, or place indiscriminately: for in order to conceive how the sea could first form a mountain of clay, and then crown it with rocks, we have only to consider, that the sediment might be transported from different places, and that they might consist of different materials. The sea might transport from one place several sediments of clay, and afterwards deposit sediments of stony matter; either because all the clay at the bottom, or on the coasts was exhausted, and then the waves would attack the rocks; or, rather, because the first sediments were transported from one place, and the last from a different one. Besides, the latter corresponds exactly

with experience; for, it is a known fact, that beds of earth, stone, gravel, sand, &c. follow no rule of arrangement, but are placed indifferently, and, as it were, by chance, one above another.

This chance, however, ought to have some rules, which can only be discovered by analogy and probable conjecture. We have seen, that, according to my theory of the formation of the globe, its interior parts should consist of vitrified matter, similar to vitrified sand, which is only the fragments of glass, and of which the clays are the scoriæ, or decomposed parts. Agreeably to this supposition, the centre of the earth, and even near the surface itself, should be composed of glass or vitrified matter, and above this should be found sand, clay, and other scoriæ. Thus the earth, in its original state, was a nucleus of glass or vitrified matter, either compact like glass, or divided like sand, (for that circumstance depends on the degree of heat applied;) above this matter was sand; and, lastly, clay. The soil, or external covering, was produced from the air, and the mud of water; and it is more or less thick according to the situation of the ground; more or less coloured, according to the different mixtures of mud, sand, clay, and the parts of decayed animals and vegetables; and more or less fertile, according to the abundance or deficiency of these parts. To show that this account of the formation of sand and clay is not altogether imaginary, I shall add a few remarks.

I suppose the earth, in its first state, to have been a spheroid of compact glass, covered with a thin crust of pumice-stone, and other scoriæ of melted matter. The agitation of the air and of the water would soon reduce this crust of pumice into powder or sand, which, by uniting into masses, would give rise to free-stone and flints, the varieties of which, with regard to colour and density, depend upon the different degrees of fineness of the sand that composed them.

The constituent parts of sand unite by the application of fire, become very hard, compact, and more or less transparent, according to the purity of the sand: but, on the other hand, when exposed to the action of the air, it exfoliates, falls down in the form of earth, and may thus produce clays of different kinds. This dust, which is sometimes yellow, sometimes brilliant, and is used to dry writings, is nothing else than a fine sand, somewhat corrupted, and nearly reduced to an elementary state. Its particles, in time, become so attenuated and divided, that they lose the power of reflecting light, and acquire all the properties of clay. On examining a piece of clay, many of these shining or talky particles appear; because they have not yet entirely lost their original form. Sand, therefore, in process of time, may produce clay; and this clay, by a farther division, acquires the qualities of mud or slime, a vitrifiable matter of the same nature with clay.

This theory is confirmed by daily experience. In washing sand, the water becomes impregnated with a black, soft, fatty earth, which is a genuine clay. The mud swept from streets paved with free-stone is black and very fat, and, when dried, it discovers itself to be an earth of the same nature with clay. Clay, taken from places where there is neither flint nor free-stone, and diluted with water, always precipitates a great quantity of vitrifiable sand.

But, what clearly demonstrates the existence of sand, and even of flint and glass, in clay, is, that the reunion of its parts, by the action of fire, restores it to its original form. Clay, when heated to the degree of calcination, is covered with a hard coat of enamel; if its internal parts are not vitrified, they become so extremely hard as to resist the file; they strike fire with the hammer, and acquire all the properties of flint: a great degree of heat melts and converts them into real glass.

Clay and sand, therefore, are substances perfectly analogous, and of the same kind. If clay can be condensed to flint, and even to glass, why may not sand, by resolution, become clay? Glass appears to be the true elementary earth, and all mixed bodies are only glass in disguise. Metals, minerals, salts, &c. are only a vitrifiable earth. Common stone, and other analogous bodies, testaceous and crustaceous shells, &c. are the only substances which cannot be vitrified, and which seem to form a distinct class. The former, by the action of fire, may be converted into a homogeneous, hard, and transparent substance, without any diminution of its weight, and upon which no farther change can be made. The latter, on the contrary, which consist of more active and volatile principles, calcine in the fire, lose more than a third of their weight, and resume the form of simple earth, without any other change than the resolution of their constituent parts. If these bodies be excepted, which are few in number, and of which the combinations produce few varieties in nature, all other substances, and particularly clay, may be converted into glass, and, consequently, are only glass in a decomposed state. If fire quickly vitrifies these substances, glass itself, whether simple, or in the form of sand or flint, naturally, but by a slow and insensible progress, resolves into clay.

In countries where flint is the predominant stone, the fields are commonly strewed with its fragments: if the place be uncultivated, and if the flints have remained long exposed to the air without being moved, their upper surface is always white; but the surface next the ground preserves its natural colour, which is very brown. When these flints are broken, the whiteness appears to be not superficial only, but penetrates more or less into their internal parts, and forms a belt, which in some is not very deep, but, in others, occupies nearly the whole stone. This white part is somewhat granulated, perfectly

opaque, as tender as free-stone, and adheres to the tongue like the boles. But the other portion of the flint is smooth and polished, has neither thread nor grain, and preserves its original colour, its transparency, and its hardness. When this half decomposed flint is put into a furnace, the white part becomes red like a brick, and the brown part becomes exceedingly white. Why shall we conclude, with a famous naturalist, that flints of this kind are imperfect, and that they are not old enough to have acquired their perfect state? For why should they be all imperfect? And why should they be uniformly imperfect on the side only that is exposed to the air? It is, on the contrary, much more probable, that they are changed from their original state, and partly decomposed, and that they are gradually resolving into clay or bole. If this reasoning should appear to be unsatisfactory, expose to the air the hardest and blackest flint, in less than a year the colour of its surface will be changed; and, if the experiment be farther prosecuted, the flint will be found gradually to lose its hardness, its transparency, and its other specific characters, and make daily approaches to the nature of clay.

Sand undergoes the same changes as flint. Every grain of sand may, perhaps, be considered as a small flint, and every piece of flint as a collection of fine sand cemented together. The first example of the decomposition of sand is exhibited in that shining but opaque powder, called *mica*, with which clay and slate are always impregnated. The quartz, or perfectly transparent flints, in decomposing, produce fat and soft talks, such as those of Venice and Russia, which are as ductile and vitrifiable as clay; and it appears, that talk is the mean between glass, or transparent flint, and clay; but that the gross and impure flints, in decomposing, are converted into clay without any intermediate state.

Our made glass undergoes the same change: when long exposed to the air, it decomposes, and, as it were, corrupts. At first, it assumes a number of colours, then it exfoliates, and in handling it, we perceive that many shining particles fall off. But, when its decomposition is farther advanced, it bruises between the fingers, and is reduced to a very white, talky, and impalpable powder. Art also imitates nature in the decomposition of glass and flint. 'Est etiam certa methodus, solius aquæ communis ope, silices et arenam in liquorem viscosum, eundemque in sal viride convertendi, et hoc in oleum rubicundum, &c. Solius ignis et aquæ ope, speciali experimento, durissimos quosque lapides in mucorem resolvo, qui distillans subtilem spiritum exhibet, et oleum nullis laudibus prædicabile.' (Vid. Becher. Phys. Subterr.)

These matters shall be more fully considered when we treat of metals. We shall here only add, that the different strata of the globe consist either of materials which may be considered as actual vitrifications, or analogous to glass, and possessing its most essential qualities. It is also evident, that, from the decomposition of glass and flint, which daily takes place, there results a genuine clay. Hence we may conclude, with a high degree of probability, that sand and clays have originally been the scoriæ of burnt matter, especially when we join to the above circumstances, the proofs *a priori* which have been employed to show that the earth was formerly in a state of liquefaction occasioned by the operation of fire.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE VIII.

Of Shells, and other Productions of the Sea, found in the Interior Parts of the Earth.

I HAVE often examined quarries, the stones of which were full of shells. I have seen whole hills composed of shells, and chains of rocks intermixed with shells through their whole extent. The quantity of shells, and other productions of the sea, is, in many places, so prodigious, that it is difficult to believe any more of them existed in their natural element. It is from this enormous quantity that no doubt remains of the earth's having continued for a very long time under the waters of the sea. The number of sea-shells found in a fossil or petrified state is so amazing, that, were it not for this circumstance, we never should have had a proper idea of the suprizing quantities of those animals to which the ocean gives birth. We must not, therefore, imagine, like those who talk and reason concerning things they never saw, that shells are only to be found scattered here and there by chance, or in small heaps, like those of oysters thrown from our doors. They appear,

on the contrary, in masses like mountains, in banks of 100 or 200 leagues in length. They may often be traced through whole provinces, and in masses of 50 or 60 feet thick. It is only after having learned these facts that a man is entitled to reason on this subject.

The shells of Turenne may serve as a striking example. Let us attend to the description given of them by the historian of the Academy. (Année 1720, p. 5.)

'Though figured stones, and even fossil shells found in 'the bowels of the earth were remarked in all ages and 'nations, they were generally considered, even by philo- 'sophers, as lusus naturæ; the production of them was 'ascribed to chance, or to some unaccountable and for- 'tuitous train of circumstances; and, of course, this 'wonderful phænomenon added nothing to the stock of 'knowledge. An ignorant potter in Paris, who knew 'neither Greek nor Latin, about the end of the 16th 'century, was the first man who ventured, in opposition 'to all the learned, to affirm, that fossil shells were real 'shells originally deposited by the sea, in those places 'where they are found; that real animals, and particu- 'larly fishes, bestowed on figured stones their various 'forms, &c.; and he boldly defied the whole school of 'Aristotle to invalidate his proofs. His name was Ber- 'nard Palissy; and he was perhaps the most conspi- 'cuous example of a philosophical genius, unimproved 'by art or learning. His system, however, has lain 'dormant for nearly a century, and even his name has 'almost been forgotten. At last, several philosophers 'revived Palissy's ideas; and science has derived great 'advantage from all the fossil shells and figured stones 'which have appeared in the earth: they are now per- 'haps, become too common, and the consequences 'drawn from them too incontestible.' [The corres- pondence of Palissy's ideas with those of the ancients, is worth remarking. 'Conchulas, arenas, buccinas, 'calculos varie infectos, frequenti solo, quibusdam 'etiam in montibus reperiri, certum signum maris allu- 'vione eos coopertos locos volunt Herodotus, Plato, 'Strabo, Seneca, Tertullianus, Plutarchus, Ovidius, et 'alii;' vide Dausqui, Terra et Aqua, p. 7.]

'But Reaumur's late observations on the subject are 'astonishing. He discovered a mass below ground of '130,680,000 cubic fathoms of shells, either whole or 'in fragments, without the least mixture of stone, earth, 'sand, or other foreign matter. Before this remarkable 'instance, fossil shells never appeared in such enormous 'quantities, nor without being mixed with other bodies. 'This prodigious mass lies in Turenne, more than 36 'leagues from the sea. It is of great service to the pea- 'sants of that province; they use the shells for marl in 'fertilizing their lands, which would otherwise be per- 'fectly barren.

'What the peasants dig out of the earth, to the depth 'of eight or nine feet, consists only of fragments of 'shells; but these fragments are easily recognized to be 'those of real shells; for they still retain their original 'channels or furrows, and have only lost their lustre and 'varnish, as most shells do, after having remained long 'under ground. The smallest fragments are only dust; 'but we know them to be the dust of shells, because they 'consist of the very same matter with the larger frag- 'ments, and the entire shells, which are sometimes found. 'The species both of the large fragments and of the entire 'shells, are easily distinguishable. Some of these species 'belong to the coast of Poitou, and others of them to 'foreign shores. This mass likewise furnishes corals, 'and other productions of the sea. *Falun* is the name 'by which this matter is distinguished in that province; 'and it is found, wherever the ground is dug, through 'an extent of about nine leagues square. The peasants 'never dig deeper than about 20 feet; because, says 'Reaumur, they imagine that the expence of labour 'would exceed the value of the commodity. They 'might, however, dig deeper. But our calculation of '130,680,000 cubic fathoms proceeds upon the suppo- 'sition of only 18 feet deep, and 2200 fathoms to the 'league. Every article, therefore, is undervalued, and 'this mass of shells must greatly exceed the above cal- 'culation; if the quantity be only doubled, this won- 'derful phænomenon will be greatly augmented.

'In physical facts, there are little circumstances, 'often overlooked by the bulk of mankind, which are, 'notwithstanding, of great consequence in illustrating 'the subject. M. de Reaumur has remarked, that all 'the fragments of shells lie horizontally in the great 'mass; from which he concludes, that the fragments 'were not deposited at the same time with the entire 'shells which originally formed this mass; because, 'says he, the superior shells would, by their weight, 'have broken the inferior ones, and the fragments, in 'that case, would necessarily have been disposed in a 'thousand different directions. The whole, therefore, 'whether entire or broken, must have been gradually 'transported thither by the sea, and, of course, their 'position must have been horizontal. But, though 'time alone was sufficient to break them down, and 'even to calcine them, it could not vary their original 'position. Their transportation must have been gra- 'dual; for, it is impossible that such an immense num- 'ber of shells could be suddenly crowded together, and 'yet preserve a position uniformly horizontal; and their 'being assembled in one place, demonstrates this place 'to have once been the bottom of a gulf or bason.

'Though there are many vestiges of the universal 'deluge which is recorded in Scripture, yet the mass of 'shells at Turenne could not be an effect of this deluge. 'Perhaps such an amazing mass is no where to be 'found, even in the bottom of the sea. But, supposing 'the deluge to have forced such a quantity from the

'ocean, they would necessarily be carried off with vio-
'lence and precipitation; and, consequently, could
'never have been deposited in the same position. They
'must have been transported, slowly floating in the
'waves; and, of course, their accumulation would re-
'quire a much longer time than a year.

'Upon the whole, it is plain, that, either before or
'after the deluge, the earth, at least some parts of it,
'must have been in a very different situation from what
'it now appears; that the sea and land must have had a
'different arrangement; and that there was formerly a
'great gulf in the middle of Turenne. The changes
'recorded in history, or even in ancient fable, are incon-
'siderable; but they give us some idea of what might
'be produced in a long series of ages. M. de Reaumur
'conjectures, that Turenne was formerly a gulf of the
'sea, and that the shells were transported by a current.
'But this is only a mere conjecture, thrown out to sup-
'ply the place of a fact as yet imperfectly known. Be-
'fore any certain conclusion can be drawn, we must
'have geographical charts of all those places where
'shells are found below the surface of the earth. To
'accomplish this, much time and numberless observa-
'tions are requisite. Science, however, may in time
'be carried thus far.'

An attention to the following circumstances will lessen our surprize at this great collection of shells: 1. Shell-fish multiply prodigiously, and arrive at maturity in a very short time. The multitude of individuals in every species is a demonstration of their amazing fertility. In a single day, for example, a mass of oysters, of several fathoms in thickness, is often raised; the rocks to which they are attached diminish considerably in a short time; and some banks are entirely exhausted. The following year, however, furnishes an equal quantity, and not the smallest diminution appears. It is even doubted, whether a natural bed of oysters was ever entirely exhausted. 2. The substance of shells is analogous to that of stone; they are long preserved when immersed in soft matter; and they easily petrify when connected with matter naturally hard; these fossil shells, therefore, and other productions of the sea found on land, being the spoils of many ages, must necessarily have accumulated into large masses.

We have already remarked the prodigious quantities of shells preserved in marble, lime-stone, chalk, marl, &c. They appear in masses like hills or mountains; and often compose more than one half of the bodies in which they are contained. Sometimes they appear entire, and at other times in fragments, but large enough to enable us to distinguish their respective species. Here our knowledge of this subject, derived from observation, stops. But I go farther, and maintain, that shells are the medium employed by nature in the formation of most stones; that chalk, marl, and lime-stone, consist entirely of the dust or fragments of shells; and, consequently, that the quantity of decomposed shells is infinitely greater than that of those which have been preserved. These positions shall be fully established in the section upon minerals; and I shall only here exhibit the point of view in which the different strata of earth ought to be considered. The first bed, in which nothing of the original structure appears, is composed of mud deposited by dews, rains, and snow, and of particles of animal and vegetable substances. The inferior beds of chalk, marl, lime-stone, and marble, are composed of the spoils of shells and other sea-bodies, mixed occasionally with entire shells or fragments of them. But clay and vitrifiable sand are the materials which compose the internal parts of the globe. These substances were vitrified at the time the earth assumed its figure, which necessarily implies, that the whole was then in a melted state. The different species of granite, flint, free-stone in large masses, slate, and coal, derive their origin from sand and clay, and are also disposed in beds. But tufa and pumice, free-stone and flint in small or detached pieces, crystals, metals, pyrites, most minerals, sulphurs, &c. are matters, the formation of which is recent, when compared with that of marble, calcinable stones, chalk, marl, and other substances that are disposed in horizontal beds, and contain shells or other relicks of the ocean.

As the terms I have employed may appear obscure or ambiguous, it is necessary to explain them. By *clays*, I mean not only the white and yellow clays, but likewise the blue, the soft, the hard, the laminated, &c. which I consider to be the scoriæ of glass, or the decompositions of glass. By *sand*, I always understand vitrifiable sand; and I comprehend, under this denomination, not only the fine sand which produces free-stone, and which I maintain to be the powder of glass, or rather of tufa, but also that sand rubbed off free-stone, and the still grosser kind resembling small gravel, proceeding from granite and rock-stone, and which is brittle, angular, and reddish, and generally found in the beds of those rivers which descend precipitately from hills or mountains composed of granite or common rock. The river Armanson, which runs by Semur in Auxois, where all the stones are of common rock, carries down great quantities of this gross, rough, and brittle sand. It is of the same nature with rock-stone, of which it is only small portions, as calcinable gravels are only particles of free-stone. Besides, rock-stone and granite are the same substances; but I have used both terms, because they are considered by some as different species. The same may be remarked of flints and of free-stone in large masses: these also are species of granite; and I call them flints in large masses, because, like calcinable stones, they are disposed in beds, and also to distinguish them from flints and free-stone in small masses, as the

round flints and sand-stones, which have no continuation, or are not found in beds of any extent. These are recent productions, and have not the same origin as flint and free-stone in large masses, which form regular and extensive strata. Under *slate* I comprehend the blue, the white, the grey, the reddish, and all the plated stones. These bodies are generally found below laminated clay, and seem to be nothing else but clay hardened into thin strata by drying; and this is the reason of so many cracks or fissures remarkable in such substances. Coal and jet are likewise referable to clay, and are found under the laminated clays or slate. By *tufa* I mean not only the common pumice, which is full of holes, and has an organized appearance, but all beds of stone formed by the sediments of running waters, all the stalactites, incrustations, and every kind of stone that dissolves by fire. It does not admit of a doubt that all these are new substances, and that they are constantly growing. Tufa is only a mass of stony matter, not distinguished by regular strata. This matter is commonly found in small hollow cylinders, is regularly shaped, formed by rills or percalations at the foot or upon the declivities of hills, and consisting of coats of marl or calcareous earth. The cylindric form is the specific character of this kind of tufa, and it is always either oblique or straight, according to the directions of the rills by which it is produced. The extent of these spurious quarries is inconsiderable, and generally proportioned to the height of the mountains which furnish the materials of their growth. The intervals between the cylinders of the tufa, by the daily addition of fresh stony matter, are at last filled up, and the whole assumes a compact and solid form; but it never acquires the hardness of stone, and, for that reason, is denominated by Agricola, *marga tofacea fistulosa*. In the tufa are often found impressions of the leaves of such trees and plants as grow in the neighbourhood; land-shells, well preserved, are likewise frequently found in the tufa, but never sea-shells; it is therefore a recent production, and ought to be ranked with stalactites, incrustations, &c. All these new substances are a kind of spurious stones, formed by the wasting of others, but never arrive at the consistence of real petrifaction.

Crystal, precious stones, every stone that has a regular figure, and even flints in small masses, and concentric coats, whether found in the perpendicular fissures of rocks, or elsewhere, are only exudations, or the concreting juices of flint in large masses; they are, therefore, new and spurious productions, the genuine stalactites of flint or of granite.

Shells are never found in common rock or granite, nor in free-stone, although they often appear in vitrifiable sand, from which free-stone derives its origin. This circumstance seems to indicate, that sand, unless when perfectly pure, cannot unite into free-stone or granite; and that a mixture of shells, or of other heterogeneous bodies, totally prevents it from cementing. I have often examined those small round stones, found in beds of sand which are mixed with shells, and never could discover in them a single shell. These round stones are true concretions of free-stone, formed in those places where the sand is pure, and not mixed with heterogeneous matter; which is the reason why no larger masses are produced.

We formerly remarked, that, at Amsterdam, which is a very low country, sea-shells were found 100 feet below the surface, and at Marly-la-Ville, 6 leagues from Paris, at the depth of 75 feet. They have also been found in mines below beds of rock of 50, 100, 200, and even of 1,000 feet thick, as it is apparent in the Alps and Pyrenees, where shells and other sea bodies are found in the inferior strata of immense rocks, which have been cut through in a perpendicular direction. But to proceed in order: Shells are found in the mountains of Spain, France, and England, in all the marble quarries of Flanders, in the mountains of Gueldres, in all the hills round Paris, in those of Burgundy and Champagne; in a word, in all places where the basis is not composed of free-stone or tufa; and, in all these places, the substance of the stones consists more of shells than of any other matter. By shells, I mean not only the remains of shell-fish, but likewise those of crustaceous animals, the bristles of sea-hedge-hogs, and all the productions of sea-insects, as corals, madrepores, astroites, &c. Any man may be convinced, by the evidence of his own eyes, that, in most marbles and calcinable stones, the proportion of sea-bodies is so great, as to exceed the matter by which they are united.

But, farther, sea-bodies are found even on the tops of the highest mountains of the Alps; for example, on the top of Mount Cenis, in the mountains of Genes, in the Appennines, and in most of the stone and marble quarries of Italy. They appear in the stones of which the most ancient buildings in Rome are constructed, in the mountains of Tyrol, in the centre of Italy, on the top of Mount Paterne near Boulogne, in the hills of Pouille, in those of Calabria, in many parts of Germany and of Hungary, and, lastly, in all the high grounds of Europe. (See Steno, Ray, Woodward, &c.)

In Asia and Africa, travellers have observed sea-shells in several places; for example, 'upon the Castravan mountains, above Baruth,' says Shaw, (see Shaw's Travel's, p. 344.) 'where there is a curious bed of whitish 'stone, but of the slate-kind, which contains, in every 'fleak of it, a great number and variety of fishes. These, 'for the most part, lie exceedingly flat and compressed, 'like the fossil fern plants; yet, at the same time, they 'are so well preserved, that the smallest strokes and 'lineaments of their fins, scales, and other superficial

'diversities, are easily distinguished.' Between Cairo and Suez, and particularly upon all the hills of Barbary, says the same author, are many petrified shells and echini; most of them exactly correspond with the different species still existing in the Red Sea. As to Europe, petrified fishes are to be met with in Switzerland, Germany, the quarry of Oningen, &c.

Fossil shells, says M. Bourguet, are to be found in the long chain of mountains stretching from Portugal to the most easterly parts of China, in the valleys of Europe, and in all the mountains of Africa and America; and hence, he remarks, we may conclude, that they also exist in those parts of the globe with which we are still unacquainted.

The islands of Europe, Asia, and America, wherever men have had occasion to dig, whether in the mountains or in the valleys, furnish many specimens of fossil shells; and this circumstance demonstrates, that islands are analogous in structure and formation to their neighbouring continents, (see Lettres Philosoph. sur la Formation des Sels, p. 205.)

These facts are sufficient to prove, that fossil shells, petrified fishes, and other productions of the ocean, exist in great quantities in almost every place where proper investigations have been made. 'It is true,' says Tancrid Robinson, 'that sea-shells are dispersed occasion-'ally on the earth by armies, and by the inhabitants of 'towns and villages. La Loubere relates, in his voyage 'to Siam, that the monkeys of the Cape of Good Hope 'perpetually amuse themselves by transporting shells 'from the shores of the sea to the tops of the moun-'tains. But this is no solution to the question, why 'these shells are dispersed through every climate of the 'earth, or why they are found in the bowels of the 'highest mountains, and disposed in beds, like those in 'the bottom of the ocean.'

Upon perusing an Italian letter, printed at Paris in 1746, concerning the changes this globe has undergone, I was astonished to find a repetition of Loubere's senti ments. Petrified fishes, in the opinion of this writer, are always of rare species, which were rejected from the Roman tables, because they were not esteemed to be wholesome. And as to fossil shells, he says, that the pilgrims brought from Syria, in the time of the crusades, those shells peculiar to the Levant, which are now found petrified in France, in Italy, and in other parts of Christendom. Why did he not add, that the monkeys transported shells to the tops of the highest mountains, which never were inhabited by men? This he might have done with great facility, and it would have given an air of credibility to his hypothesis! How should men, who pretend to philosophy, differ so widely in their opinions? It is not sufficient, it would appear, to find fossil shells in almost every part of the earth where pits have been dug, nor to have quoted the testimonies of natural historians, as these authors may, according to certain systems, have imagined that shells existed where none were to be found. We shall, therefore, to prevent all prejudices of this kind, quote the authority of some authors who had no theory to support, and whose habits of observation could only enable them to recognize shells that were entire, and in the best preservation. This testimony will, perhaps, have greater authority with men who cannot judge of the facts, nor know the distinction between real shells and their petrifactions.

Every man may examine with his eyes the banks of shells in the hills round Paris, and especially in the stone-quarries, as at Chaussée near Seve, at Issy, Passy, and other places. A great quantity of lenticular stones are to be found at Villers-Cotterets; the rocks are almost entirely composed of these stones; and they are irregularly interspersed with a kind of cement, by which they are united. At Chaumont the quantity of shells is so great, that the whole hills, which are pretty high, appear to consist of nothing else. The same phænomenon is exhibited at Courtagnon near Rheims, where there is a bank of shells of about four leagues broad, and the length is still more considerable. I mention these places because they are famous, and the shells strike the eyes of every beholder.

With regard to foreign countries, let us attend to the remarks of travellers.

'In Syria and Phœnicia, in the neighbourhood parti-'cularly of Latikea, the rocks are of a hard chalky sub-'stance, from whence the adjacent city might borrow 'the name of the *White Promontory*. The Nakoura, 'formerly called the *Scala Tyriorum*, is of the same 'nature and complexion; both of them including a 'great variety of corals, shells, and other remains of the 'deluge,' (see Shaw's Travels, p. 344.)

'But fossil shells, and other the like testimonies of 'the deluge, are very rare in the mountains near Sinai, 'the original menstruum, perhaps, of these marbles, 'being too corrosive to preserve them. Yet, at Corondel, 'where the rocks approach nearer to our free-stone, I 'found a few chamæ and pectunculi, and a curious 'echinus of the discoid kind. The ruins of the small 'village at Ain-el-Mousa, and the several conveyances 'we have there for water, are all of them full of fossil 'shells. The old walls of Suez, and the remains that 'are left us of its harbour, are likewise of the same ma-'terials, all of them probably from the same quarry 'Between Suez and Cairo, likewise, and all over the 'mountains of Lybia, near Egypt, every little rising 'ground and hillock discovers great quantities of the 'echini, as well as of the bivalve and turbinated shells, 'most of which exactly correspond with their respective 'families still preserved in the Red Sea,' (Shaw's Travels, p. 444.)

The moving sand in the neighbourhood of Raz Sem,

in the kingdom of Barca, covers many palm-trees, echini, and other petrifactions. *Raz Seme* signifies *the head of a fish*, and is the name of what is called the petrified village, where it has been alledged, that men and women, with their children, cattle, furniture, &c. may be seen converted into stone. 'But,' says Mr. Shaw, 'all this is mere fiction, as I learned not only from Mr. 'Mair, Consul at Tripoli, who sent several people to 'examine into the fact, but also from men of credit and 'learning who had been on the spot.'

Near the Pyramids Mr. Shaw discovered some stones which had been hewn by workmen, and were mixed with little round bodies like lentils, and some of them resembled barley half peeled. 'These,' he says, 'were 'supposed to have been fragments of victuals left by 'the workmen, and are now petrified. But this account 'appears to be very improbable,' &c. These lentils and grains of barley are nothing but petrified shells, known to every naturalist by the name of lentil-stones.

'Many fossil stones,' says Misson, (See Voyage de Misson, tom. iii. p. 109.) 'are found in the neighbour-'hood of Maestricht, especially near the village of 'Zichen or Tichen, and in the mountain called the '*Huns*.

'In the environs of Sienne, near Certaldo, are many 'mountains of sand filled with different kinds of shells. 'Monte-mario, about a mile from Rome, is also full of 'them. I have remarked them in the Alps, in France, 'and in other places. Olearius, Steno, Camden, Speed, 'and many other writers, have related the same phæno-'menon. (Ibid. tom. ii. p. 312.)

'The island of Cerigo,' says Thevenot, (Voyage de Thevenot, tom. i. p. 25.) 'was called *Porphyris* by the 'ancients, on account of the quantities of porphyry 'found in it.' Now, porphyry, as observed above, is composed of the prickles of the echinus, or sea-hedge-hog, united by a very hard stony cement.

'Opposite to Inchené, a village on the east bank of 'the Nile, I found petrified plants growing naturally on 'a piece of ground about two leagues in length, and of 'an inconsiderable breadth. This is one of the most 'singular productions in nature. The plants resembled 'the white corals which grow in the Red Sea. (See Voyage de Paul Lucas, tom. ii. p. 380.)

'There are several species of petrifaction on Mount 'Libanus, and, among others, flat stones which contain 'the skeletons of fishes entire, and well preserved; ches-'nuts, and small branches of coral, of the same species 'with what grows in the Red Sea, are likewise found 'on this mountain.' (Ibid. tom. iii. p. 326.)

'In Mount Carmel,' says Shaw, 'we gather a great 'many hollow stones, lined in their insides with a variety 'of sparry matter, which, from some distant resem-'blance, are said to be petrified olives, melons, peaches, 'and other fruit. These are commonly bestowed upon 'pilgrims, not only as curiosities, but as antidotes 'against several distempers: the olives, which are the '*lapides Judaici*, as they are commonly called, have been 'always looked upon, when dissolved in the juice of 'lemons, as an approved medicine against the stone and 'gravel.' (See Shaw's Travels, p. 444.) These *lapides Judaici* are the points of the echinus.

'M. la Roche, a physician, gave me some petrified 'olives, called *lapides Judaici*, which grow in great 'quantities upon the mountains, where are to be found, 'according to my information, other stones, which in 'their inside contain perfect representations of the na-'tural parts of men and women.' (Voyag. de Monconys, p. 334.) These are the hysterolithes.

'In going from Smyrna to Tauris,' says Tavernier, 'when we came to Tocat, the heat was excessive; we 'therefore left the common road to the north of us, and 'went by the mountains, where there are always shade 'and cool breezes. In many places we found snow; 'and, upon the tops of some of these mountains, we 'saw shells resembling those upon the sea-shore, which 'is an extraordinary phænomenon.'

Let us attend to what Olearius says concerning the petrified shells he observed in Persia, and in the rocks where the sepulchres have been cut near the village Pyrnarus.

'Three of us ascended, by mutually assisting each 'other, the most frightful precipices, and at last gained 'the summit, where we found four large chambers, with 'several niches cut out of the solid rock: but what 'struck us most was, to find in this vault, on the top of 'the mountain, muscle-shells; and in some parts they 'appeared in such quantities, that this whole rock 'seemed to consist of nothing but sand and shells. In 'returning from Persia, we perceived several of these 'shelly mountains upon the coasts of the Caspian Sea.'

To these authorities many others might be added, were I not apprehensive of tiring those who need no additional proofs on this subject, and who have perceived with their eyes, as I have done, the existence of shells in all places where they have been searched for.

In France, we find not only the shells belonging to our own coasts, but those which never appeared in our seas. Some philosophers even alledge, that the number of foreign petrified shells greatly exceeds those of our our own climate. But this opinion seems not to be well founded; for, independent of such shells as lie in the bottom of deep water, and are seldom brought up by fishers, and, of course, are regarded by us as foreigners, though they may exist in our seas, I find, upon comparison, that more of the petrified shells belong to our own shores than to any other. For example, all the pectines, most cockles, muscles, oysters, trumpet-shells, ear-shells, limpets, nautili, stars, tubulites, corals, madrepores, &c. which are found so universally, are really

produced in our seas: and, though many sea-bodies appear, which are either foreign or unknown, as the cornu ammonis, the lapides Judaici, the large screw, the buccinum, called *abajour*, &c. yet I am convinced, by repeated observation, that the number of these species is inconsiderable, when compared with the shells which belong to our own coasts. Besides, the madrepores, astroites, and all those sea bodies formed by insects, constitute the basis of our marbles and lime-stone; for the shells, however abundant, make but a small part of these stones, and many of them are produced in our own seas, and particularly in the Mediterranean.

The Red Sea produces corals, madrepores, and sea-plants, more abundantly than any other. The port of Tor furnishes an amazing quantity. In calm weather, the quantity exhibited is so great, that the bottom of the sea resembles a forest. Some of the branched madrepores rise from eight to ten feet high. They are also very common in different parts of the Mediterranean; and are to be found in all gulfs, islands, &c. of every temperate climate, where the sea is not very deep.

M. Peyssonel was the first who discovered that coral, madrepores, &c. were not plants, but that they derived their origin from animals. The truth of this discovery was long doubted. Some naturalists at first rejected it with disdain. But it soon gained universal assent; and every man is now satisfied, that what was formerly called sea-plants, are nothing but hives, or rather lodges, formed by insects for their own habitation. These bodies were originally classed with minerals, then with plants, and now they must for ever be recognized as the genuine operation of animals.

Many shell fish inhabit the deepest parts of the ocean, and are never thrown upon the coasts; authors have, therefore, termed them *Pelagiæ*, to distinguish them from the other kinds, which they call *Littorales*. It is probable that the cornu ammonis, and some other species, found only in a petrified state, belong to the former, and that they have been impregnated with stony matter in the very places where they are discovered. It is also probable, that the species of some animals have been extinguished, and that these shells may be ranked among their number. The extraordinary fossil bones found in Siberia, in Canada, in Ireland, and several other places, seem to confirm this conjecture; for no animal has hitherto been discovered to whom bones of such an enormous size could possibly belong.

Fossil shells, says Woodward, are found from the top to the bottom of quarries, in pits, and in the deepest mines of Hungary: and we are informed by Mr. Ray, that they are found in the rocks on the shores of Calda, and in Pembrokeshire, at the depth of 200 fathoms. (See Ray's Discourses, p. 178.

Shells not only appear in a petrified state at great depths, and on the tops of the highest mountains, but they are also found in their natural condition, having the colour, lustre, and lightness, of sea-shells; so that, to be fully satisfied on this subject, nothing farther is requisite than to compare them with the shells found in the shores of the sea. The slightest examination will convince us, that petrified and fossil shells are precisely the same with those of the ocean; for they are marked with the same furrows and articulations, however minute; and, in the glossopetri and other teeth of fishes, which are sometimes found adhering to the jaw-bone, it is obvious, that the teeth are worn and polished at the extremities, and that they have been used by the living animals.

Fossil shells are almost every where to be met with; and, of those of the same species, some are small, others large, some young, others old, some entire, others imperfect; and sometimes young ones appear adhering to the old.

The shell-fish called *Purpura* has a long tongue, the extremity of which is so sharp and osseous, that it pierces the shells of other fishes, in order to extract nourishment from them. Shells pierced in this manner are often found in the bowels of the earth; which is an incontestible proof that they were formerly inhabited by living fishes, and that they existed in the same places with the purpura. (See Woodward, p. 296, 300.)

The obelisks of St. Peter's at Rome, according to John of Latran, were said to have been brought from the Egyptian pyramids: they consist of a red granite, which, as formerly remarked, contains no shells. But the ancient marbles of Africa and Egypt, and the porphyry said to have been brought from Solomon's temple, and the palaces of the Egyptian kings, and employed in several of the Roman buildings, are full of shells. Red porphyry is composed of an infinite number of the prickles of that species of echinus called a sea-chesnut; they are placed very near each other, and form the white points of the porphyry. Each of these points have a black speck in the middle, which is the section of the longitudinal tube of the prickle of the echinus. At Ficin in Burgundy, three leagues from Dijon, there is a red stone so similar to porphyry, that it differs only in density, not being harder than marble: it is entirely composed of the points or prickles of the echini, and the stratum of it is considerable both in thickness and extent. Many excellent pieces of workmanship are made of it in this province, and particularly the steps which lead to the pedestal of the equestrian statue of Louis le Grand at Dijon. This species of stone is also found in Montbard in Burgundy; it is softer than marble; but it contains still more prickles of the echini, and a smaller proportion of red matter. Thus the ancient porphyry of Egypt, and the porphyry of Bungundy, differ only in the degree of hardness, and in the quantity of prickles or points of the echinus contained in them.

With regard to what is called green porphyry, I imagine it to be rather a granite than a porphyry. It is not, like the red porphyry, composed of the prickles of the echinus; and its substance has a greater resemblance to that of common granite. The ancient walls of Volatera in Tuscany have been built of stones in which are many shells, and these walls were erected 2500 years ago, (see Steno de solido intra solidum, p. 63.) Most marbles, porphyries, and other stones employed in the buildings of the ancients, contain shells and other productions of the ocean, in the same manner as some of our modern marbles. Hence we may conclude, that, independent of the testimony of Holy Writ, the earth, before the deluge, was composed of the same materials as at present.

Upon the whole, it is apparent, that petrified shells are found in Europe, Asia, Africa, and every place where proper researches have been made. They are also found in America, in the Brazils, for example, in Tucumana, in Terra Magellanica, and in such vast quantities in the Antilles, that what the inhabitants call lime, which lies immediately below the soil, is nothing but a congeries of shells, corals, madrepores, astroites, and other sea-bodies. These incontestible facts would have led me to conclude, that petrified shells, and other productions of the ocean, were to be found through the whole continent of America, and especially in the mountains, as Woodward affirms. But M. de la Condamine, who lived several years in Peru, assures me, that he was never able to discover any of them in the Cordeliers, although he had diligently searched for them. This phænomenon would indeed be singular, and would lead to conclusions still more uncommon. But, I confess, the testimony of this celebrated observer notwithstanding, I am strongly inclined to believe that there is, in the mountains of Peru, as well as every where else, petrified shells and other sea-bodies, although they have not yet been discovered. In matters which depend on testimony, the positive evidence of two witnesses is a complete proof; but the evidence of ten thousand witnesses who only declare in the negative, that they never observed a particular appearance, gives rise to nothing more than a slight doubt. Thus reason, joined to the force of a general analogy, obliges me to persist in believing that fossil shells will still be found in the mountains of Peru, especially if they are searched for in the sides, and not on the very summits.

The tops of high mountains are generally composed of granite, free-stone, and other vitrifiable materials, which never contain shells. These matters were all formed out of beds of sand, when they were covered by the sea. But, when the waters left the mountains, they would carry off the sand, and other light bodies into the plains, and leave nothing on their tops but those beds of rock which had been formed below the stratum of sand. At two, three, or four hundred fathoms below the summit of these mountains, we often find marbles and other calcinable matters, disposed in parallel beds, and containing shells and other sea bodies. Hence, if M. de la Condamine examined only the most elevated places, which consist of granite, of free-stone, or of vitrifiable sand, it is not surprising that he did not find fossil shells. But he ought to have explored the lower parts of the Cordeliers, and he would unquestionably have discovered beds of marble, earth, &c. mixed with shells; for such beds have been found in every part of the world that has undergone a proper examination.

But, supposing it to be a fact, that there are no productions of the ocean in the mountains of Peru, nothing could be concluded from it which could affect our theory. Some parts of the globe, and particularly places of such elevation as the Cordeliers, might never have been covered with the sea. These mountains, however, would be an ample field for curious observation. They would not, in that case, consist of parallel beds. Their materials would be very different from all others: they would have no perpendicular fissures: the structure of the stones and rocks would have no resemblance to those of other countries: *lastly*, these mountains would exhibit the ancient structure of the earth before it was changed by the motion of the waters; they would discover the primitive state of the globe, its original form, the natural arrangement and connection of its parts. But this notion is supported by too slender a foundation; and it is more consonant to the rules of philosophy to believe that fossil shells exist in the mountains of Peru, in the same manner as they exist every where else.

With regard to the position of shells in beds of earth or of stone, let us attend to the following passage of Woodward: 'All the shells that are found in numberless 'strata of earth, and rocks, in the highest mountains, 'and in the most profound quarries and mines, in flint, 'cornelian, agate, &c. and in masses of sulphur, marca-'sites, and other mineral and metallic bodies, are filled 'with the same substances that compose the strata in 'which they are included, and never with any heteroge-'neous matter;' p. 206, &c. 'We now find in the sand-'stone of all countries (the specific gravity of the several 'sorts whereof is very little different, being generally to 'water as $2\frac{1}{2}$ or $\frac{3}{1\,2}$ to 1,) only those conchæ, pectines, 'cochlæ, and other shells that are nearly of the same 'gravity, viz. $2\frac{1}{2}$ or $2\frac{1}{8}$ to 1. But there are ordinarily 'found enclosed in it prodigious numbers; whereas, of 'oyster-shells, (which are in gravity but as about $2\frac{1}{4}$ to '1,) of echini, (which are but as 2 or $2\frac{1}{4}$ to 1,) or the 'other lighter kinds of shells, scarcely one ever appears 'therein. On the contrary, in chalk (which is lighter 'than stone, being but as about $2\frac{1}{10}$ to 1,) there are only 'found echini, and the other lighter sorts of shells;' p. 32, 33.

It must here be remarked, that what Woodward says

with respect to specific gravity, is not universally true; for shells of different specific gravities are often found in the same matters; shells of cockles, of oysters, and of echini, for example, are found in the same bed of stones or of earth. In the cabinet of the French King, there is a cockle petrified in a cornelian, and echini petrified in an agate. Hence the difference in the specific gravity of shells has had less influence upon their position in the strata of the earth than Woodward would have us to believe. The reason why the shells of the echini, and others of a light texture, abound so much in chalk, is owing to this circumstance, that chalk itself is only decomposed shells; those of the echini being lighter and thinner than others, would be most easily reduced to powder or chalk; and hence beds of chalk could exist only in those places where were formerly collected by the sea great quantities of light shells, the destruction of which would form that chalk in which we still find shells that have resisted the operation of time, either in an entire state, or in fragments sufficient to discover their species.

This subject shall be more fully treated of in the article concerning Minerals. I shall here only observe, that Woodward's expressions are often too general. He appears to assert, that shells are found as frequently, and in as great abundance, in flints, cornelians, chalcedonii, ores, and sulphur, as in other matters. But the fact is, that shells are a very rare phænomenon in vitrifiable or purely inflammable substances; and, in chalk, marl, and marbles, the quantity of them is so prodigious, that it is impossible to affirm that the lighter and heavier shells are uniformly found in strata corresponding to their specific gravities, though, in general, this may be the case, oftener than otherwise. They are all impregnated with the bodies in which they are immersed, whether in the horizontal beds, or in the perpendicular fissures; because the whole has been affected by the operation of water, though at different times and in different manners. Those found in the horizontal beds of stone, marble, &c. have been transported and deposited by the waves of the sea; and those found in flints, cornelians, and other matters peculiar to the perdendicular fissures, were formed by rills of water impregnated with lapidific or metallic substances. In both cases, the matter that fills the shells has been in the state of a fine, impalpable powder; because every pore of them is completely filled, aud the moulds of them are as exact as the impressions of a seal upon wax.

It is therefore apparent, that, in stone, marble, &c. there are multitudes of shells so entire, and so well preserved, that they may be compared with those in our cabinets, or upon the shores of the sea.

'There being, I say, besides these, such vast multi-
'tudes of shells contained in stone, &c. which are entire,
'fair, and absolutely free from any such mineral conta-
'gion; which are to be matched by others at this day
'found upon our shores, and which do not differ in any
'respect from them; being of the same size that those
'are of, and the same shape precisely; of the same sub-
'stance and texture, as consisting of the same peculiar
'matter, and this constituted and disposed in the same
'manner as is that of their respective fellow-kinds at
'sea; the tendency of the fibres and striæ the same; the
'composition of the lamellæ, constituted by these fibres,
'alike in both; the same vestigia of tendons (by means
'whereof the animal is fastened and joined to the shell);
'in each the same papillæ; the same sutures, and every
'thing else, whether within or without the shell, in its
'cavity, or upon its convexity, in the substance, or upon
'the surface of it. Besides, these fossil shells are at-
'tended with the ordinary accidents of the marine ones,
'*ex. gr.* they sometimes grow to one another, the lesser
'shells being fixed to the larger: they have the balani,
'tubuli vermiculares, pearls, and the like, still actually
'growing upon them. And, which is very considerable,
'they are most exactly of the same specific gravity with
'their fellow-kinds now upon the shores. Nay, farther,
'they answer all chymical trials in like manner as the
'sea-shells do; their parts, when dissolved, have the
'same appearance to view, the same smell and taste,
(Woodward, p. 23, 24.)

I have often observed, with astonishment, whole mountains, chains of rocks, and extensive quarries, so full of shells, and other sea bodies, that there was hardly space left for the matters in which they are deposited.

I have seen some arable fields so full of petrified cockles, that they might be picked up by a blind man, others entirely covered with cornu ammonis, and others with cardites; and the more this subject is inquired into, we shall be the more thoroughly convinced, that the number of petrifactions is infinite, and that it was absolutely impossible that all the animals which inhabited these shells could exist at the same time.

I have farther remarked, that the stones of those arable lands which abound with petrified shells in an entire form, well preserved, and detached from all other matter, are frittered down by frost, which destroys stones, but has little effect upon petrified shells.

These immense quantities of petrified sea-bodies, found in so many different places and situations, prove, that they could not be transported and deposited by the waters of the deluge; for the greatest part of them, instead of being found in the bowels of the earth, and in solid marble at the depth of seven or eight hundred feet, must have remained on the surface.

In all quarries, petrified shells form part of the internal structure of the stone, the surface of which is often covered with stalactites, a matter much less ancient than the stone that contains the shells. Another proof

that these shells could not be derived from the deluge is, that the bones, horns, claws, &c. of land animals are seldom found in a petrified state, and are never incorporated in marble, or other hard stones; whereas, if these effects had been produced by the deluge, the remains of land-animals would have been found in marbles, as well as those of fishes.

To alledge, that the earth was entirely dissolved at the time of the deluge, is a mere gratuitous supposition, which required a second miracle in order to give water the power of an universal dissolvent. Besides, it infers an evident contradiction; for, if water was then an universal menstruum, how could shells have been preserved in the entire state in which we find them? This is an evident demonstration, that no such dissolution took place, and that the parallel strata were not formed in an instant, but were gradually produced by successive sediments; for, it is apparent to every observer, that the disposition of all the materials composing the earth has been occasioned by the operation of water. The only question, therefore, that remains, is, whether this arrangement of parts was produced all at once, or in a succession of time? Now, it has already been shown, that it could not possibly happen at one time; because the materials are not disposed according to their specific gravities, and because they never suffered a general dissolution. This arrangement, therefore, must have originated from successive sediments. Any other cause, or particular revolution, would have given rise to an arrangement totally different. Besides, particular revolutions, or accidental causes, could never have produced a uniform disposition of horizontal and parallel strata throughout the whole globe.

Let us attend to what the historian of the Academy has said upon this subject. (Année 1718, p. 3.)

'The many marks of extensive inundations, and the 'manner in which mountains must be conceived to have 'been produced, demonstrate, that the surface of this 'earth has suffered great revolutions. However deep 'we penetrate into the globe, we discover nothing but 'ruins, bodies of different kinds amassed and incorporated without any order or apparent design. If there 'be any regularity in the structure of the earth, it lies 'too deep for our researches; we must, therefore, con'fine ourselves to the ruins of the external crust, which 'will be sufficient to occupy the attention of philo'sophers.

'M. de Jussieu discovered, in the neighbourhood of 'St. Chaumont, a great quantity of slaty or laminated 'stones, every lamina of which was marked with the im'pression of a stem, leaf, or other portion of some plant. 'The impressions of leaves were uniformly extended, 'as if they had been stretched in the stones by the hand; 'a clear demonstration that they had been transported 'by water, which always keeps leaves in that position: 'their situations were various, and sometimes they lay 'across each other.

'It is natural to imagine, that a leaf deposited by 'water upon soft mud, and then covered by a similar 'layer of mud, would impress upon the undermost layer 'the figure of its one side, and upon the uppermost the 'figure of its opposite side; and, after these layers hard'ened and petrified, that they would each bear an im'pression of a different side of the leaf. But this sup'position, however natural, does not take place: the two 'laminæ of stone uniformly bear the impression of the 'same side of the leaf, the one in alto, the other in bas'relief. For this observation, with regard to the figured 'stones of St. Chaumont, we are indebted to M. de 'Jussieu; but we leave the explication of it to himself, 'and shall proceed to remarks of a more general and 'interesting nature.

'All the impressions on the stones of St. Chaumont 'are of foreign plants, which are not to be found in any 'part of France; they are natives either of the East 'Indies, or of the warmer climates of America. Most 'of them belong to the capillary tribes, and they are 'generally particular species of ferns, the close texture 'of which enables them both to make deep impressions, 'and to remain long in a state of preservation. M. 'Leibnitz was astonished to find the impressions of the 'leaves of a few East India plants upon some stones in 'Germany. In the example under consideration, the 'wonder is greatly augmented; for, by some unaccount'able destination of nature, it would appear, that, in all 'the stones of St. Chaumont, not a single impression 'of a native plant is to be found.

'From the number of fossil shells in the mountains 'and quarries exhibited in this country, as well as in 'many others, it is apparent, that it must have formerly 'been covered with the sea. But how could the Ame'rican or Indian oceans come hither?

'To solve this and other surprising phænomena, we 'may suppose, with much probability, that the sea ori'ginally covered the whole globe. But this supposition 'will not answer; because no terrestrial plants could 'then exist: the plants of one country, therefore, could 'only be transported to another by great inundations.

'M. de Jussieu imagines, that, as the bed of the sea 'is always rising higher by means of the mud and sand 'incessantly carried into it by the rivers, the sea, at first 'confined by natural dikes, might at last surmount them, 'and spread over the land to great distances; or, which 'would produce the same affect, the dikes might in time 'be rendered so thin, by the constant operation of the 'water, that they would at last give way. Soon after 'the formation of the earth, when nothing had assumed 'a regular or settled form, sudden and prodigious revo'lutions might then be produced, of which we have now 'no examples, because every thing is in such a fixed

'and permanent state, that only slow and inconsiderable 'changes can take place: it is for this reason that we 'find a difficulty in crediting revolutions more sudden and tremendous.

'By some of these great revolutions the West or East 'Indian Oceans might have been poured in upon Eu-'rope: in their journey, they would tear up foreign 'plants, carry them off floating on the waves, and gently 'deposit them in shallow places, from which the waters 'would soon evaporate.'

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE IX.

Of the Inequalities upon the Earth's Surface.

THOUGH the inequalities upon the surface of the earth may be considered as a deformity in its figure, they are absolutely necessary to vegetation and animal life. To be convinced of this fact, we need only consider what would be the condition of the earth, were its surface perfectly smooth and regular. Instead of those beautiful hills which furnish abundance of water for supporting the verdure of the earth, instead of those richly garnished fields, where plants and animals find an easy and comfortable subsistence, a dreary ocean would cover the whole globe, and the earth deprived of all its valuable and alluring qualities, would be an obscure abandoned planet, suited only for the habitation of fishes.

But, independent of moral considerations, which seldom ought to be employed in natural philosophy, the surface must, from a physical necessity, have been irregular; for, supposing it to have been originally smooth and level, the motion of the waters, subterraneous fires, the winds, and other external causes, would necessarily produce, in time, irregularities similar to those which we now behold.

Next to the elevation of mountains, the depths of the ocean form the greatest inequalities. This depth is exceedingly diversified, even at great distances from land. In some places the sea is said to be a league in depth; but that is a rare phænomenon; and the most common depths are from 60 to 150 fathoms. Gulfs and branches of the ocean, which run in upon the land, are still less deep; and straits are generally the most shallow places.

Depths are commonly sounded by a piece of lead, of 30 or 40 pounds weight, fixed to a small rope. This method answers well enough for ordinary depths, but it is liable to error when the depth is very great; for the cord being specifically lighter than water, after much of it has been wound down, the weight of the lead and that of the cord become nearly equal to their bulks of water; then the lead descends no more, but runs off in an oblique line, and floats at the same depth. Hence, in sounding great depths, an iron chain, or some body heavier than water, should be employed. It is for want of attention to this circumstance, that some navigators have been led to maintain, that the sea, in many places, has no bottom.

In general, the depths in open seas augment or diminish in a pretty regular manner, being commonly deeper the farther from land. But to this remark there are many exceptions; for there are places in the middle of the sea, as at the *Abrolhos* in the Atlantic, where large shelves appear; and there are, in other places, vast sand-banks, well known to the mariners who sail to the East Indies.

Along coasts, the depths are likewise very irregular. However, it may be laid down as a certain rule, that the depth is always proportioned to the height of the coast. The same observation applies to rivers.

It is easy to measure the height of mountains, either geometrically, or by the barometer. This instrument determines the height of a mountain pretty exactly, especially in countries where its variation is not considerable, as at Peru and other equatorial climates. By one or other of these methods, the height of most mountains has already been ascertained; for example, it has been found, that the highest mountains of Switzerland exceed Canigau, the most elevated of the Pyrennees, 1600 fathoms. (See Hist. de l'Acad. 1708, p. 24.) These mountains appear to be the highest in Europe, since they give rise to a great number of rivers which run into different and very distant seas, as the Po, which empties itself in the Adriatic, the Rhine, which loses itself in the sands of Holland, the Rhone, which falls into the Mediterranean, and the Danube, which runs into the Black Sea. These four rivers, the mouths of which, are so distant, derive part of their waters from Saint Godard and the neighbouring mountains; a clear proof that this place is the most elevated part of Europe.

Mount Taurus, Imaus, Caucasus, and the mountains of Japan, are higher than any in Europe. The mountains of Africa, as the great Atlas, and the mountains of the Moon, are at least equally high with those of Asia; and the highest of all are those of South America, and

especially of Peru, which are 3000 fathoms above the level of the sea. In general, the tropical mountains are more elevated than those of the temperate zones, and those of the latter are higher than those nearer the poles. Thus, the nearer the equator, the greater are the superficial inequalities, which, though considerable with regard to us, are nothing when estimated in relation to the whole globe. A difference of 3000 fathoms in 3000 leagues diameter, is but a fathom to a league, or a foot to 2200 feet, and, upon a globe of 2½ feet, would not make the 16th part of a French line. Hence this earth, which to us appears to be traversed and intersected by mountains of an enormous height, and by seas of a dreadful depth, is, in relation to its size, but slightly furrowed with inequalities so inconsiderable, that they cannot make any variation upon its general figure.

In continents, the mountains form continued chains; but, in islands, they are more interrupted, generally rise in the form of a cone, or pyramid, and are distinguished by the name of peaks. The Peak of Teneriffe, in the Island of Fer, is one of the highest mountains in the earth; it is nearly a league and a half perpendicular above the level of the sea. The Peak of St. George in one of the Azores, and the Peak of Adam in the Island of Ceylon, are likewise exceedingly high. These peaks are composed of rocks, piled above each other; and all of them throw out, from their summits, fire, ashes, bitumen, minerals, and stones. Some islands, as St. Helena, Ascension Isle, and most of the Canaries and Azores, are only the tops or points of mountains. It is also worthy of remark, that the middle of most islands, promontories, and capes, is the most elevated, and that they are generally divided into two parts, by chains of mountains which run in the direction of their greatest length: in Scotland, for example, the Grampian mountains (Grans-bain) extend from east to west, and divide the island of Great Britain into two parts: the same thing takes place in Sumatra, the Lucca Islands, Borneo, Celebes, Cuba, St. Domingo, the peninsulas of Corea and Malaya, &c. Italy is also longitudinally traversed by the Appennines.

Mountains, as mentioned above, are of different heights; the hills are lowest; then follow the mountains of an ordinary height, which are succeeded by a third range still higher. All these are commonly covered with trees and plants; but neither of them furnish springs except at their bottoms. In the last and highest range, we find nothing but sand, loose stones, flints, and rocks, the tops of which often reach above the clouds. Precisely at the foot of these rocks, are little plains, or hollows, which collect rains and snow, and form those ponds, morasses, or fountains, from which the rivers derive their sources. (See Lettres Philosophiques sur la Formation des Sels, &c. p. 198.)

The figure of mountains is likewise very different. Some consist of long chains of nearly an equal height; others are intersected by deep valleys; the contours of some mountains are pretty uniform; those of others are most irregular, and sometimes a detached little mountain appears in the middle of a plain or valley. There are also two kinds of plains; some occupy the low grounds, and others appear in the mountains. The former are generally divided by some large river; but the latter, though their extent be considerable, are dry, or furnished with a small rill only. The plains in the mountains are often exceedingly high, always of difficult access, and form one country above another, as in Auvergne, Savoy, and other elevated provinces. The soil of them is firm, and produces plenty of herbs and odoriferous plants, which make them the finest pasture-grounds in the world.

The tops of high mountains are composed of rocks of different elevations, which, when viewed at a distance, make them resemble the waves of the sea. (See ibid. p. 196.) This is not the only reason for our affirming that mountains were formed by the motions of the sea; I only mention it, because it corresponds with every other phænomenon. But the following facts put this point beyond all controversy: the fossil-shells, and other sea-bodies, every where found in such profusion, that they could not possibly be transported from the sea, in its present state, into continents so distant, and deposited at such great depths in the bowels of the mountains: the universal parallelism of the different strata, an effect which could only be produced by water, and the composition even of the most dense of them, as those of stone and marble, which clearly evinces, that, before their formation, they had been reduced into a fine powder, and precipitated to the bottom in the form of sediments: the exactness with which the fossil shells are moulded in the matters in which they are found: the cavities of fossil shells, which are uniformly filled with the same substances that contain them: the corresponding angles of hills and mountains, which nothing could effect but the currents of the ocean: the equality in the heights of opposite hills, and the different strata uniformly appearing at the same levels: and, lastly, the direction of mountains, the chains of which extend longitudinally, like the waves of the sea.

With regard to the depths or hollows on the surface of the earth, those of the ocean are unquestionably the greatest. But, as these are hid from human view, and can only be discovered by sounding, we shall confine ourselves to those which appear on the dry land, such as deep vallies, precipices found between rocks, abysses that present themselves in high mountains, as the abyss of Mount Ararat, the precipices of the Alps, the valleys of the Pyrennees, &c. These depths are a natural consequence of the elevation of mountains; they receive the water and earth carried down from the high grounds;

their soil is generally fertile; and they are full of inhabitants. The precipices among rocks are often occasioned by a sudden sinking of one side, the base, which generally inclines more one way than another, being loosened by the action of the air, and of frost, or by the violence of torrents. But abysses, or those enormous precipices that appear on the tops of some mountains, and, to the bottom of which, though their circumference be a mile and a half, or three miles round, it is impossible to descend, have been formed by the operation of fire. They have been the furnaces of ancient volcanoes, the matter of which has been exhausted by explosions, and the long action of fires that are now extinguished by the defect of combustible matter. Of this kind is the abyss of Mount Ararat, described by Tournefort. It is surrounded with rocks which are black and burnt. The abysses of Etna and of Vesuvius will have the same appearance after their inflammable materials are exhausted.

In Plot's History of the County of Stafford in England, there is an account of a kind of gulf, which was sounded by a rope of 2600 feet, without finding either water or bottom, the rope being too short. (See Journal des Savans, 1680, p. 12.)

The greatest cavities, and the deepest mines, are generally in the mountains, and seldom descend to the level of the plains. By them we discover the internal structure of the mountain only, not that of the globe itself.

Besides, these depths are not very considerable. Mr. Ray affirms, that the deepest mines exceed not half a mile. The mine of Cotteberg, which, in the time of Agricola, was esteemed to be the deepest in the world, was only 2500 feet of perpendicular depth. There are, indeed, holes in particular places, as that mentioned by Plot, or Pool's Hole in the county of Derby, the depth of which is probably very great: but none of them bear any sensible proportion to the thickness of the globe.

If the kings of Egypt, in place of erecting pyramids as monuments of their vanity and riches, had expended equal sums in making profound excavations into the bowels of the earth, to the depth of perhaps a league, they might have discovered substances which would have recompensed their labour; they would at least have extended the knowledge of the earth's internal structure, which might have been productive of much utility.

But, let us return to the mountains. The highest of them lie between the tropics; and the nearer we approach to the equator, the greater are the inequalities on the earth's surface. A short enumeration of mountains and islands will be sufficient to establish this point.

In America, the Cordeliers, which are the highest mountains in the world, lie precisely under the equator, and they extend on both sides a considerable way beyond the Tropic circles.

The highest mountains of the Moon, of Monomotapa, and the great and little Atlas, in Africa, lie either under or very near the equator.

In Asia, Mount Caucasus, the chain of which, under different names, runs into China, and through this whole extent, lies nearer the equator than the poles.

In Europe, the Pyrennees, the Alps, and the mountains of Greece, which form one chain, are still less distant from the equator than the pole.

These chains of mountains, of which we have given an enumeration, are higher, and of greater extent, both in length and in breadth, than those of more northern countries. With regard to their direction, the Alps form a continued chain which runs across the whole Continent from Spain to China. They commence on the sea-coast of Galicia, join the Pyrennees, traverse France, by Vivares and Auvergne, run through Italy, and stretch into Germany, above Dalmatia, until they reach Macedonia; from thence they join the mountains of Armenia, the Caucasus, the Taurus, the Imaus, and at last terminate on the coast of Tartary. Mount Atlas, in the same manner, traverses the whole Continent of Africa, from the kingdom of Fez to the straits of the Red Sea. The mountains of the Moon have likewise the same direction.

But the mountains of America have an opposite direction. The vast chains of Cordeliers, and other mountains, run more from south to north than from east to west.

What we have now remarked concerning the greatest elevations of the land, applies equally to the greatest depths of the sea. The most extensive and deepest seas lie nearer the equator than the poles: from these united observations, the truth of our general position, that the greatest inequalities of the globe are to be found in the equatorial regions, is sufficiently established. These irregularities on the surface of the earth give rise to a number of curious phænomena. Between the Indus and the Ganges, for example, there is a large peninsula, through the middle of which runs a chain of high mountains, called the *Gate*, which extends from north to south, from the extremity of Mount Caucasus to Cape Comorin. One side of this peninsula forms the coast of Malabar, the other that of Coromandel. On the Malabar side, between the chain of mountains and the sea, the season of summer is from September to April; and, during these months, the sky is serene, and no rain falls. But on the Coromandel coast, which lies on the other side of the mountains, this very period is their winter, and the rains fall in torrents. This reverse of summer and winter happens, in some places, no farther distant than 20 leagues; so that, by crossing the mountains, a man has it in his power to change seasons. The same thing, it is said, takes place at Cape Razalgate in Arabia, and even in Jamaica, which is divided from east to west

by a chain of mountains. On the south side of these mountains, the plantations enjoy the warmth of summer, while those on the north suffer all the rigours of winter. Peru, which is situated under the line, and extends about 1000 leagues towards the south, is divided into three long and narrow portions, called by the inhabitants *Lanos, Sierras,* and *Andes.* The Lanos, which are the plains, extend along the coast of the South sea; the Sierras are hills interspersed with valleys; and the Andes are the famous Cordeliers, the highest mountains of the world. The Lanos are about 10 leagues broad; the Sierras, in many places, 20 leagues; and the Andes nearly the same, though some parts of them are more, and others less broad. The breadth of these divisions is from east to west, and their length from south to north. This part of the world exhibits the following remarkable appearances: first, along the whole coast of the Lanos, a south-west wind almost constantly blows, which is contrary to the ordinary direction of the wind in the Torrid Zone. Second, in the Lanos, it never rains or thunders, though there are plenty of dews. Third, it rains almost continually at the Andes. Fourth, in the Sierras, which lie between the Lanos and the Andes, it rains from September to April.

It was long thought that all high mountains run from west to east, till the contrary direction was discovered in America. But M. Bourguet was the first who remarked the surprising regularity in the structure of these great masses. After passing the Alps thirty times in fourteen different places, the Appennines twice, and making several tours in the neighbourhood of these mountains, and of mount Jura, he found, that the contours of all mountains have a near resemblance to the works in regular fortifications. When the direction of a mountain is from west to east, all its projections, or advances, stretch to the south and north. This amazing regularity is so remarkable in the valleys, that a man is apt to imagine he is walking in a covered way. If, for example, a man travels in a valley from north to south, he perceives that the mountain which lies to the right hand makes projections to the east, and that the projections of the opposite mountains regard the west, in such a manner, that the prominent and concave angles, on each side, alternately correspond with one another. When the valleys are large, the angles of the mountains are less acute, because they are more distant from each other, and the declivity is not so rapid or steep. These angles are not perceptible in plains, except when we station ourselves on the banks of the rivers, which generally occupy the middle of the plains, and whose natural windings correspond to the most advanced angles or projections of the mountains. It is astonishing that such an obvious fact should have remained so long unnoticed; for, it is apparent, that, in valleys lined with opposite mountains, when the declivity of one of the mountains is less rapid than that of the other, the course of the rivers is not in the middle, but nearer to the steepest mountain. (See Lettres Philosophiques sur la Formation des Sels, p. 181, 200.)

These general observations might be confirmed by a multitude of facts. The mountains of Switzerland, for example, are steeper on the south side than on the north, and on the west side than on the east. This appearance is obvious in Mount Gemmi, Mount Brisa, and in almost all the other mountains in this country, the highest of which are those which separate Vallesia, and the Grisons of Savoy, from Piedmont and Tyrol. These countries are, indeed, a continuation only of the same mountains, the chain of which extends to the Mediterranean; and the Pyrennees are a continuation only of that vast mountain which commences in Upper Vallesia, whose branches stretch far to the west and south, and preserve, throughout that whole extent, a great height; but, on the north and east sides, they gradually sink into plains, as appears in those extensive countries which are traversed by the Rhine and Danube before they finish their course, while the Rhone descends with rapidity to the south, and empties itself in the Mediterranean. The same observation is exemplified in the mountains of England and of Norway. But the most perfect example is afforded by the mountains of Chili and Peru. The Cordeliers are exceedingly steep on the west side; but they have a gradual declivity to the east, and terminate in vast plains, which are watered by the greatest rivers in the world. (See Phil. Trans. Abridg. vol. vi. part 6, p. 158.)

M. Bourguet, to whom we are indebted for the discovery of the correspondence between the angles of mountains, calls this discovery *the Key to the Theory of the Earth.* However, he appears not to have perceived its whole importance; for, in his treatise on this subject, he gives the skeleton only of an hypothetical system, in which most of his conclusions are either false or uncertain. The theory that we have delivered rests upon four principal facts, the truth of which, after examining the proofs that support them, cannot admit of a doubt. The *first* is, that the earth, to very considerable depths, is every where composed of parallel strata of different matters, which were formerly in a fluid or soft state: the *second,* that the sea has, for many ages, covered the whole earth which we now inhabit: the *third,* that the tides and other motions of the waters, produce inequalities in the bottom of the sea: and the *fourth,* that the figure and corresponding direction of mountains, have originated from currents in the ocean.

After perusing the proofs contained in the subsequent articles, the reader will be enabled to determine whether I am right in maintaining, that these facts, when firmly established, will likewise ascertain the general theory of the earth. What has been remarked concerning the formation of mountains needs no farther explication.

But, as it may be objected, that I have not accounted for he formation of peaks, or pointed mountains, nor for some other particular facts, I shall add such observations as have occurred upon this subject.

I have endeavoured to form a distinct and general idea of the manner in which the materials composing this earth are arranged, and have reduced the whole to two classes. The first includes all the matters which are disposed in horizontal or regularly inclined beds or strata; and the second comprehends all those matters which appear in detached masses, in ridges, or in veins, either perpendicular, or irregularly inclined. In the first class I rank sands, clays, granites, flints, and free-stones in large masses, pit-coal, slates, and likewise marls, chalk, calcinable stones, marbles, &c. In the second, I include metals, minerals, crystals, precious stones, and flints in small masses. Under these two classes, all the known materials of the earth are comprehended. Those of the first class owe their origin to sediments transported and deposited by the waters of the sea, and ought to be distinguished into such as are calcinable by the application of fire, and such as melt, and are convertible into glass. The matters comprehended under the second class are all vitrifiable, with the exception of those called inflammable, or which totally consume in the fire.

There are, in the first class, two distinct species of sand; the one, which abounds more than any other matter in the globe, is vitrifiable, or rather consists of fragments of real glass. The other, which is less in quantity, is calcinable, and ought to be regarded as the dust of stone, and as differing from gravel only by the grossness of its grains. In general, vitrifiable sand lies in beds; but they are frequently interrupted by masses of free-stone, of granite, and of flint; and sometimes these substances appear in banks of a considerable extent.

Sea-shells are seldom found in this sand, or in vitrifiable bodies; and even those which appear in them are not disposed in beds, but scattered, as it were, by chance. I never, for example, found any in free-stone. This stone, which abounds in certain places, is nothing but sand united by a cement. It never appears but in countries where vitrifiable sand is frequent; and the quarries of it are generally in pointed hills, sandy lands, or interrupted eminences. These quarries may be wrought on all sides; and when they appear in large beds, they are more distant from each other than those of marble or calcinable stones. Blocks of free-stone may be cut of all dimensions; and, though it be difficult to work, its hardness is inconsiderable; for it is easily reduced to sand by friction, except the black points or nails sometimes found in it, which are so hard as to resist the best files. Common rock-stone, which I consider as a species of granite, is vitrifiable, and of a similar nature with free-stone; it is only harder, and more firmly cemented. It has likewise several dense points, which cut the shoes of travellers on mountainous grounds. It also contains a great number of talky spangles; and the whole is so hard as not to be worked without great labour.

After narrowly examining these hard points found in free-stone and granite, I discovered that they consist of metallic matter, which has been melted and calcined by a strong fire, and that they have a perfect resemblance to certain substances thrown out of volcanoes, of which I have seen vast quantities in Italy. They are called by the inhabitants *Schiarri*. They are black heavy masses, upon which neither fire, water, nor the file, can make any impression. This metallic matter is different from lava, the latter being a species of glass; but the former seems to partake more of metal than of glass. The points in free-stone and granite have a great resemblance to this matter, which is a farther proof that those substances have formerly been liquified by fire.

On the tops of some high mountains, blocks of granite appear in great quantities. The positions of these blocks are so irregular, that they seem to have been thrown together by accident; and we should be apt to imagine that they had tumbled down from some neighbouring height, if the places where they are found were not higher than any neighbouring ground. But their vitrifiable nature, and their angular and square figures, like those of free-stone rocks, discover these substances to have an uncommon origin. Thus, in large strata of vitrifiable sand, we find blocks of free-stone and granite, the figure and situation of which follow not exactly the horizontal position of strata. The rains have gradually brought down from the hills and mountains the sand with which these blocks were originally covered, by furrowing and cutting into those intervals that appear between the yolks or nuclei in free-stone, in the same manner as the hills of Fountainbleau are intersected. Every point of a hill resembles a nucleus in free-stone quarries, and all the intervals have been scooped out by the rains, and the sand they originally contained has been carried down to the valleys. In the same manner, the angular blocks of granite on the tops of high mountains were formerly covered and surrounded with vitrifiable sand, which, being gradually carried off by the rains, left the blocks in the position in which they happened to be formed. These blocks are generally pointed at the top, and augment in thickness towards their bases; one block often rests upon another, that upon a third, and so on, leaving irregular intervals between them. And as, in the course of time, the sand which covered the blocks, and filled the intervals, was washed down by the rains, there would nothing remain on the tops of high mountains but pointed piles of irregular blocks; and hence the origin of peaks, or mountains ending in sharp points.

For, let it be supposed, as may easily be proved by the sea-bodies found in the Alps, that this chain of mountains was formerly covered by the ocean, and that a thick bed of vitrifiable sand was deposited upon their tops, which reduced the whole chain to a level country. This bed of sand would necessarily give rise to large blocks of granite, of free-stone, of flint, and of other bodies, the consistence and figure of which originate from sand, nearly in the same manner as salts crystallize. These blocks, after the sand which covered them, and filled their interstices, was carried down to the plains, by rains, torrents, &c. would maintain their original stations, remain bare on the tops of the mountains, and contitute all those peaks or pointed eminences so frequently exhibited by nature. To the same origin must be ascribed those high detached rocks which are found in China and other countries, as in Ireland, where they are distinguished by the name of *devil's stones*, and the formation of which, as well as of peaked mountains, has hitherto appeared so difficult to explain. The explication, however, which I have given, is so natural, that it generally occurs to every person, who examines these objects; and, on this occasion, I will set down a passage from Father Tartre. 'From Yanchuin-yen we arrived 'at Hotcheou. Upon the road we remarked a singular 'phænomenon, namely, rocks of a surprising height, 'resembling square towers, in the midst of vast plains. 'I cannot account for this appearance, unless I be al-'lowed to suppose these rocks to have formerly consti-'tuted a part of mountains, and that the earth, sand, 'and other loose parts, had been gradually washed away 'by the rains, and left rocks bare on all sides. What 'fortifies this conjecture is, that we saw some of them, 'the bases of which were still surrounded with earth to 'a considerable height.' (See Lettres Edifiantes, tom. i. p. 135.

The tops of the highest mountains, often for 200 or 300 fathoms, consist of rocks of granite, free-stone, and other hard and vitrifiable substances: below these, we frequently meet with quarries of marble, or hard calcinable stone, full of fossil shells; as may be seen at the great Chartreuse in Dauphiny, and upon Mount Cenis, where the stones and marbles which contain shells are situated some hundreds of fathoms below the points or peaks of high mountains, though these beds of stone and marble be more than 1000 fathoms above the level of the sea. Thus those mountains which have peaks or points generally consist of vitrifiable rocks; and those, the summits of which are flat, contain, for the most part, marbles, and hard stones full of sea-bodies. The same remark holds with regard to hills; for those composed of granite or free stone are generally intersected with points, eminences, cavities, and small valleys. But those composed of calcinable stone are nearly of an equal height, and are only interrupted by larger and more regular valleys, with corresponding angles; and they are crowned with rocks, uniform and level in their position.

Though these two species of mountains seem to be very different, their figures have been produced by the same cause, as has already been shown: but, it may be remarked, that the calcinable stones have suffered no change since the original formation of the horizontal strata. The vitrifiable sands, however, may have been changed and interrupted by the subsequent production of rocks and angular blocks which take place in sand-beds. Both species have fissures. Those in calcinable rocks are almost always perpendicular; but those of granite and free-stone are somewhat more irregular in their direction. It is in these fissures that metals, minerals, crystals, sulphur, and all the substances of our second class, are found. Below the fissures, the waters assemble, penetrate the earth, and give rise to the veins of water which every where appear under the surface.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE X.

Of Rivers.

I HAVE already remarked, that, in general, the greatest mountains occupy the middle of continents; that those of a smaller kind divide islands, peninsulas, and promontories; that, in the Old Continent, the direction of the greatest chains of mountains is from west to east; and that those which run to the north or south are only branches of the principal chains. It will appear on examination, that the greatest rivers have the same direction, and few of them follow the course of the branches of mountains. To be convinced of this fact, we have only to run our eye over a common globe; and, beginning with Spain, we shall find that the Vigo, the Douro,

the Tagus and the Guadiana, run from east to west, and the Ebro from west to east; and that there is not a river of any consideration which runs from south to north, or from north to south, although Spain be almost entirely environed by the sea on the northern and southern parts. This remark concerning the rivers of Spain demonstrates, that the direction of the mountains, is from west to east; that the southern provinces near the Straits are more elevated than the coast of Portugal; that, in the northern parts, the mountains of Galicia, the Asturias, &c. are a continuation only of the Pyrennees; and that this elevation of the country, both in the south and north, is the cause which prevents the rivers from running to the sea in these directions.

In examining the map of France, it is apparent, that the Rhone is the only river which runs from north to south; and, even near one half of its course, from the mountains to Lyons, is from east to west: but the direction of all the great rivers, as the Loire, the Charente, the Garonne, and even the Seine, is from east to west.

The same observation holds with regard to Germany. The Rhine, like the Rhone, has the greatest part of its course from south to north: but the other large rivers, as the Danube, the Drave, and all the rivers which fall into them, run from west to east, and empty themselves in the Black Sea.

The Black Sea, which should rather be regarded as a large lake, is, from east to west, nearly three times as long as from south to north; and consequently its direction is similar to that of the rivers. The same remark is applicable to the Mediterranean, which is nearly six times longer from east to west than from north to south.

The Caspian, it must be acknowledged, according to the chart made by order of the czar Peter I. extends more from north to south, than from east to west. But the ancient charts represented it as nearly round, or rather as extending more from east to west than in the opposite direction. If, however, the lake Aral be considered as a part of the Caspian, from which it is separated by a sandy plain only, the greatest extent of this sea will still be from west to east.

The course of the Euphrates, of the Persic Gulf, and of almost all the rivers of China, is likewise from west to east. The rivers of the interior parts of Africa observe the same direction, running either from west to east, or from east to west. The Nile, and the rivers of Barbary, are the only ones which run from south to north. There are, it is true, large rivers in Asia, as the Don, the Wolga, &c. which partly run from north to south: but they only observe this direction in order to fall into the Black and Caspian Seas, which are lakes in the interior parts of the country.

We may therefore lay it down as a fact, that, in general, the rivers and Mediterranean waters of Europe, Asia, and Africa, run or stretch more from east to west than from north to south. This is a natural consequence of the parallel direction of the different chains of mountains. Besides, the whole continent of Europe and of Asia is broader from east to west than from north to south: for the direction of mountains may be considered in two points of view. In a long and narrow continent, like that of South America, which contains only one principal chain of mountains extending from south to north, the rivers, not being restrained by any parallel chain, must run in channels perpendicular to the range of these mountains, that is, either from east to west, or from west to east; and this, in fact, is the direction of all the great rivers in America. But though, both in the Old and New Continent, the great rivers run in the same direction, this effect is produced by different causes. The rivers, in the Old Continent, run from east to west, because they are confined by many parallel chains of mountains which stretch from west to east; but those of America observe the same direction, because there is only one chain of mountains stretching from south to north.

The rivers generally occupy the middle of the valleys, or the lowest ground between two opposite hills: if the two hills have nearly an equal declivity, the river runs nearly in the middle between them, whether the intermediate valley be broad or narrow. If, on the contrary, the declivity of one of the hills be greater than that of the other, the river will not occupy the middle of the valley, but will approach to the steepest hill, in proporto the superiority of its declivity. In this case, the middle of the valley is not the lowest ground between the two hills, but lies much nearer the steepest of them; and consequently the river must occupy that space. This observation holds universally wherever the difference in declivity is remarkable; and the rivers never recede from the steepest hills, unless, in their course, they meet with other hills of equal declivity. In process of time, however, the declivity of the steepest hill is diminished by the rains, the melting of snow, &c. The steeper any hill is, it loses greater quantities of earth, sand, and gravel, by the operation of rains, and these substances are carried down into the plain with a proportionably greater rapidity, and, of course, force the river to change its channel, or, in other words, to retire into a lower part of the valley. It may be added, that, as all rivers occasionally swell, and overflow their banks, they carry off mud and sand, which they deposit in different parts of the valley; and, as sand and gravel are often accumulated in the channels themselves, these circumstances make the waters overflow, and alter the direction of their course. Nothing, accordingly, is more common, than to find in valleys many old channels in which the river has formerly run, especially when it is rapid, subject to frequent inundations, and carries down great quantities of sand and mud.

In plains, and extensive valleys, watered by large rivers, the channels of the rivers are commonly the lowest parts: but the surface of the water in the river is sometimes higher than the adjacent ground. When a river, for instance, begins to overflow, it soon covers a considerable part of the plain; but the banks remain longest uncovered by the water. This circumstance plainly shows that the banks of rivers are higher than the neighbouring ground; and that, from the banks, to a certain part of the plain, there is a small declivity, or slope. When, therefore, the water rises to the margin of the banks, it must be higher than the plain. This elevation of the ground on the banks of rivers is occasioned by mud and sand being deposited in the time of inundations. The water, during great swells, is always exceedingly foul and muddy: when it begins to overflow, it runs slowly over the banks, and, by depositing the mud and sand, it gradually purifies as it advances into the plain: thus, all the mud, and other substances, which are not carried down by the current, are deposited upon the banks, and gradually elevate them above the rest of the plain.

Rivers are always widest at their mouths, and turn gradually narrower towards their sources: but it is more worthy of remark, that, in the interior parts of a country, and at great distances from the sea, their course is straight, and the frequency of their windings increases proportionally as they approach to their termination. I have been informed by M. Fabry, who performed many journeys in the western parts of North America, that travellers, and even the savages, form pretty accurate computations of their distance from the sea, by observing the courses of the rivers. If a river ran straight for 15 or 20 leagues, they knew themselves to be a great way from the coast; but, if the sinuosities were frequent, they concluded that the sea was not very distant. M. Fabry, when travelling through unknown and uninhabited regions, derived much advantage from this observation. Near the sides of great rivers, the regorging of the water is likewise less apparent the farther from the sea, which furnishes another medium of judging concerning the distance: and, as the sinuosities multiply the nearer rivers approach to their mouths, it is not surprizing that some of them should yield to the pressure of the water, and give rise to several branches, or divisions, before they reach the sea.

The motion of the water in rivers is very different from the representation given of it by mathematicians. The surface, taken from bank to bank, is not level; but the middle of the stream is either higher or lower, according to circumstances, than the water at the sides. When a river swells suddenly by the melting of snow, or any other cause, its rapidity increases; and, if its course be straight, the middle of the stream, where the current is greatest, rises and forms a sensible convexity. This elevation is sometimes very considerable. M. Hupeau, who measured this difference of level between the sides and the stream of the Aveiron, found it to be three feet. This effect must always be produced when the rapidity of the current is great; for the quickness of the motion, by diminishing, or partly preventing the action of gravity, allows not to the water, in the middle of the stream, time sufficient to bring it to a level with that on the sides, and therefore, it remains higher. On the other hand, near the mouths, though the current be very rapid, the water near the sides is commonly more elevated than that of the middle: the river, in this situation, has a concave form, the lowest point of which is the middle of the stream. This effect is always produced as far as the influence of the tides is perceptible, which, in large rivers, extends sometimes to 100 or 200 leagues from the sea. It is likewise a fact well known, that the streams of rivers continue their motion a considerable way through the waters of the sea. In this case, the water of the river has two opposite motions. The middle, or current, precipitates itself towards the sea; but the action of the tide produces a counter current, or regorging, which elevates the water on the sides, while that in the middle descends; and, as all the water must be carried down by the current, that on the sides constantly descends towards the middle of the stream, with a quickness proportioned to the elevation it receives from the regorging of the tide.

There are two species of regorging, or damming up, in rivers: the first is that just now described, and is occasioned by the action of the tide, which not only opposes the natural descent of the water, but even communicates to it a contrary motion or current: the other is produced by an inactive cause, as a projection of the land, an island, &c. Though this kind of regorging gives not rise to any extraordinary counter current, it often sensibly retards the progress of small boats, and produces what it called *dead water*, which observes not the natural course of the river, but turns about in such a manner as greatly obstructs the progress of vessels. These dead waters are sensibly felt in passing through the arches of a bridge, especially if the river be rapid. The celerity with which water runs, when the height or pressure is the same, increases in proportion as the diameter of the canal, through which it passes, is diminished. The celerity of a river, therefore, in passing through a bridge, increases in the inverse proportion of the width of the whole arches, to the total width of the river. This increase of celerity, in passing through the arch of a bridge, is so considerable, that it pushes the water from the stream towards the banks, from which it is reflected, and sometimes forms violent eddies or whirlpools. In passing under the bridge of St. Esprit, the mariners are obliged scrupulously to keep the stream, even after leaving the bridge; for, if they allowed the

boat to decline either to the right or left, it would be driven with violence against the banks, or, at least, would be forced into the whirling or dead waters, from which they would find some difficulty of escaping. When the eddy is considerable, it forms a small gulf with a cylindrical void in the middle, round which the water turns with rapidity. This cylindrical cavity is an effect of the centrifugal force, which makes the water endeavour to fly off from the centre of the whirlpool.

When a great swell of the river is about to happen, the water-men perceive a particular motion, which they call a *moving at the bottom;* that is, when the water at the bottom moves with an unusual velocity, which, according to them, always indicates the approach of a sudden swell. The motion and weight of the superior waters, though not yet arrived, fail not to act upon the waters in the inferior parts of the river, and to communicate motion to them: for a river, in some respects, must be considered as a column of water contained in a tube, and its channel as a long canal, in which every motion must be communicated from one end of it to the other. Now, independent of the motion of the superior waters, their weight alone may increase the celerity of the river, and perhaps make it move quickest at the bottom; for, it is well known, that, when several boats are at once pushed into a river, they increase the motion of the water below, and retard that of the superior water.

The celerity of running waters is not in exact proportion to the declivity of their channels. A river with an uniform declivity, and double to that of another, ought not, it would appear, to run with more than a double celerity: but its celerity is much more quick, being sometimes triple, sometimes quadruple, &c. The celerity depends more upon the quantity of water, and the weight of the superior waters, than upon the degree of descent. In digging the bed of a river or drain, it is unnecessary to make the descent uniform through its whole extent. A quick motion is more easily produced by making the declivity much greater at the source than at the mouth, where, like the beds of natural rivers, it is almost imperceptible, and yet they preserve their celerity, which is more or less, according to the quantity they contain; for in great rivers, even where the ground is level, the water still runs, not only with the velocity originally acquired, but with the accumulated velocity produced by the action and weight of the superior waters. [By not attending to these circumstances, M. Khun was led falsely to affirm, that the source of the Danube was at least two German miles higher than its mouth; that the Mediterranean is 6¾ German miles lower than the sources of the Nile; that the Atlantic Ocean is half a mile lower than the Mediterranean, &c.] To make this matter still more plain, let us suppose the Seine from Pont-neuf to Pont-royal to be perfectly level, and to be ten feet deep; let us also suppose the bed of the river below Pont-royal and above Pont-neuf, to be suddenly dried up; the waters, in this case, would run both up and down the channel, till their equilibrium was perfectly restored. This effect is produced solely by the weight of the water, which never allows it to remain at rest till its particles are equally pressed on all sides, and its surface reduced to a perfect level. The weight of water, therefore, contributes greatly to increase the celerity of its motion. This is the reason why the greatest celerity in a current of water is neither at the bottom nor at the surface, but nearly in the middle, which is pressed both by the column above, and by the re-action from the bottom. But, what is still more, when a river acquires a great celerity, it will not only preserve it, though running through a level country, but even surmount heights, without spreading much to a side, or, at least, without producing an inundation of any moment.

One would be apt to imagine, that bridges, and other obstacles erected in rivers, would create a considerable diminution of celerity in their whole course. But the difference is very small. The water, upon meeting with any obstacle, rises, in order to surmount it; and the increase of celerity communicated by its fall, nearly compensates the retardation occasioned by the obstacle. Thus, sinuosities, projections from the land, and islands, create but a small variation on the total celerity of a river's course. The most considerable alterations are produced by the greater or lesser quantities of water; when the quantity is small, a river runs slow, when great, it runs with rapidity.

If rivers were always equally full, to enlarge their channels would be the best method of diminishing their rapidity, and to contain them within their banks. But, as almost all rivers rise and fall, it is more necessary, for this latter purpose, to narrow their channels; for small waters, with large channels, generally scoop out winding beds in the middle; and, when they swell, they follow the direction of these particular beds, and, by striking with violence against the banks, often do much injury to mills and other works. These bad effects might be prevented, by digging gulfs in the earth at convenient distances. To accomplish this purpose, a part of one of the banks should be cut through, and the earth removed for a considerable space. These small gulfs should be made in the obtuse angles of the river; for the water, in turning, would run into them; and, of course, its celerity would be diminished. This method might be useful in preventing the fall of bridges in places where sufficient barriers cannot be erected to resist the weight of the water.

The manner in which inundations are produced, merits particular attention. When a river swells, its celerity uniformly increases, till it begins to overflow the banks: from that moment its rapidity is checked, which is the

reason why inundations always continue several days; for, though the quantity of water should be diminished after the commencement of the inundation, it would, notwithstanding, continue to overflow; because this circumstance depends more on the celerity than on the quantity of water. If it were otherwise, rivers would often overflow their banks for an hour or two, and then retire to their channels, which never happens. An inundation, on the contrary, always lasts some days, although the rains have ceased, and less water runs in the river; because the overflowing of waters diminishes their celerity; and, consequently, although the same quantity of water arrives not in the same time as formerly, the effect is the same as if a larger quantity had been brought down. It may likewise be here remarked, that, if a high wind blows contrary to the current of the river, the inundation will be increased by this occasional cause, which diminishes the celerity of the water; but, if the wind blows in the direction of the current, the inundation will be less, and retire more quickly.

'The inundation of the Nile,' says M. Granger, 'has 'long been a subject of discussion among the learned. 'Most of them have considered it as a singular and 'wonderful phænomenon, though nothing be more 'natural or more common; for it takes place in every 'country, as well as in Egypt. The inundation of the 'Nile is occasioned by the rains which fall in Ethiopia 'and Abyssinia; but the north wind may be regarded 'as the principal cause of it: first, because the north 'wind drives the clouds which contain this rain into 'Abyssinia: second, because it prevents the water from 'running out of the mouths of the river in any great 'quantity, by damming up the stream. The great effect 'of this wind may be remarked every season; for, when 'it changes from north, the Nile loses more water in one 'day than in four.'

Inundations are generally greatest in the superior parts of rivers; because, as formerly observed, the velocity of a river uniformly increases till it empties itself in the ocean. Father Castelli, a sensible writer on this subject, remarks, that the banks, raised for the purpose of keeping the Po from overflowing, gradually diminish in height, as the river approaches to the sea; that, at Ferrara, which is 60 or 70 miles from the mouth of the river, the banks are about 20 feet above the ordinary level of the water; but that, at 10 or 12 miles from the sea, though the channel be equally narrow as at Ferrara, they are not above 12 feet. (See Racolta d'Autori che trattano del Moto dell' Acque, vol. i. p. 123.)

In fine, the theory of running waters is subject to many difficulties. It is not easy to give general rules which will apply to every particular case. For this purpose, experience is preferable to speculation. It is not enough that we know the common effects of rivers in general; but if we would reason justly, and give stability to our labours, we ought to study the peculiarities of particular rivers in which we have an interest. Though the remarks I have made be generally new, a greater collection is necessary. Perhaps we shall in time acquire a distinct knowledge of this subject, and be enabled to give certain rules for directing and confining rivers in such a manner as will prevent the destruction of bridges, banks, and other damages occasioned by the impetuosity of the waters.

The greatest rivers of Europe are, the Wolga, the course of which, from Reschow to Astracan on the Caspian Sea, is about 650 leagues; the Danube, which runs about 450 leagues, from the mountains of Switzerland to the Black Sea; the Don, the course of which, from the source of the Sosna, which receives it, to the Black Sea, is 400 leagues; the Nieper, which likewise falls into the Black Sea, after running 350 leagues; the Duina, which empties itself into the White Sea, runs a course of about 300 leagues, &c.

The greatest rivers of Asia are, the Hoanho, in China, which rises at Raja-Ribron, and after running 850 leagues, falls into the middle of the Gulf of Changi, in the Chinese Sea; the Jenisca, which runs from Lake Selinga to the northern sea of Tartary, a course of about 800 leagues; the Oby, the course of which, from Lake Kila to the north sea beyond Waigat's Straits, is about 600 leagues; the river Amour, in east Tartary, has a course of 575 leagues, from the head of the river Kerlon, which falls into it, to the sea of Kamschatka; the river Menancon may be measured from the source of the Longmu, which falls into it, to its mouth at Pulocondor; the Kian, the course of which is about 550 leagues, from the course of the Kinxa, which it receives, to its termination in the sea of China; the Ganges, which has a course nearly of the same extent with the Kian; the Euphrates, computing from the source of the Irma, which it receives, runs about 500 leagues; the Indus, which runs about 400 leagues, and falls into the Arabian Sea on the east of Guzarat; and the Sirderoias, which runs about 400 leagues, and falls into Lake Aral.

The greatest rivers of Africa are, the Senegal, the course of which, comprehending the Niger, which is a continuation of it, and the source of the Combarou, which falls into the Niger, is about 1125 leagues; the Nile, which rises in Upper Ethiopia, runs about 970 leagues. There are others, the courses of which are but partially known, as the Zaira, the Coanza, the Couama, and the Quilmanci, each of which we are acquainted with to the extent of 400 leagues.

Lastly, in America, the river of the Amazons runs more than 1200 leagues, if we reckon from the lake near Guanuco, 30 leagues from Lima, where the Maragnon rises; or, even computing from the source of the river Napo, near Quito, the course of the Amazons is

more than 1000 leagues. (See Voyage de Condamine, p. 15.)

The course of the river St. Lawrence in Canada is more than 900 leagues, computing from its mouth to Lake Ontario, from that to Lake Huron, Lake Superior, Lake Alemipigo, Lake Christinaux, and the lake of the Assiniboils, the waters of all which fall into one another, and at last into the river St. Lawrence.

The river Mississippi runs more than 700 leagues, from its mouth to any of its sources, which are not far from the lake of the Assiniboils.

The River Plata extends more than 800 leagues, from its mouth to the source of the Parana, which it receives.

The river Oronoko runs more than 575 leagues, reckoning from the source of the river Caketa, near Pasto, which partly falls into the Oronoko, and partly runs towards the river of the Amazons. (See M. Condamine's map.)

The Madera, which falls into the Amazons, extends more than 660 leagues.

In order to compute the quantity of water discharged into the sea by all the rivers, we shall suppose, which is nearly the truth, that one half of the earth's surface is sea, and the other half dry land. We shall likewise suppose the mean depth of the sea to be about 230 fathoms. The total surface of the earth is 170,981,012 square miles, and that of the sea is 85,490,506 square miles, which being multiplied by one-fourth, the depth of the sea, gives 21,372,626 cubic miles for the quantity of water contained in the whole ocean. Now, to compute the quantity discharged into the ocean by the rivers, let us take a river, the velocity and quantity of whose waters are known; the Po, for example, which passes through Lombardy, and waters a country of 380 miles in length. According to Riccioli, the breadth of the Po, before it divides into branches, is 100 perches of Boulogne, or 1000 feet; and its depth is 10 feet; and it runs at the rate of 4 miles in an hour: consequently the Po discharges into the sea 200,000 cubical perches of water in an hour, or, 4,800,000 in a day. But a cubic mile contains 125,000,000 cubic perches; of course, it will require 26 days to discharge into the sea a cubic mile of water. It only remains to determine the proportion that the Po bears to all the rivers of the earth taken together, which cannot be done exactly. But, to approach nearly to the truth, let us suppose that the quantity of water which the sea receives from the great rivers in every country, is proportioned to the extent of the surfaces of these countries; and, consequently, that the country watered by the Po, and by the rivers which fall into it, is to the total surface of the dry land as the Po is to all the rivers of the earth. Now, by the most exact charts, it appears that the Po, from its origin to its mouth, traverses a country of 380 miles in length; and the rivers which fall into it on each side arise from sources which are about 60 miles distant from the Po. Thus, the Po, and the rivers it receives, water a country 380 miles long, and 120 broad, which makes 45,600 square miles. But the surface of the dry land is 85,490,506 square miles; consequently, the quantity of water carried to the sea by all the rivers will be 1874 times greater than the quantity discharged by the Po. But, as 26 rivers, equal to the Po, furnish a cubic mile of water each day, it follows, that, in the space of a year, 1874 rivers equal to the Po, will carry to the sea 26,308 cubic miles of water; and that, in 812 years, all these rivers would discharge 21,372,626 cubic miles, which is a quantity equal to what is contained in the ocean; of course, if the ocean were empty, 812 years would be necessary to fill it by the rivers. (See Keil's Examination of Burnet's Theory, p. 126.)

It is a result of this calculation, that the quantity of water raised from the sea by evaporation, and transported upon land by the winds, is from 20 to 21 inches in the year, or about $\frac{1}{20}$ of a French line each day. This evaporation, though tripled to make allowance for what falls back into the sea from the clouds, is very inconsiderable. Mr. Halley, (see Phil. Trans. num. 192,) has clearly demonstrated, that the vapours transported from the sea, and discharged upon the land, are sufficient to maintain all the rivers and lakes in the world.

After the Nile, the Jordan is the largest river in the Levant, or even in Barbary. It discharges each day into the Dead Sea about 6,000,000 of tons. All this water, and more, is carried off by evaporation; for, according to Halley's calculation of 6914 tons evaporated from each superficial mile, the Dead Sea which is 72 miles long, and 18 broad, must lose, every day, by evaporation near 9,000,000 of tons; that is, not only all the water it receives from the Jordan, but from the smaller rivers which come from the mountains of Moab, and elsewhere. Of course, this sea has no occasion to communicate with any other by subterraneous passages. (See Shaw's Travels.)

The most rapid of all rivers are, the Tigris, the Indus, the Danube, the Yrtis in Siberia, the Malmistra in Cilicia, &c. (See Varenii Geog. p. 178.) But, as was formerly remarked, the velocity of rivers depends both on the declivity and the weight of water. In examining the globe, we find that the Danube has less declivity than the Po, the Rhine, or the Rhone; for the course of the Danube is longer, and it falls into the Black Sea, which is higher than the Mediterranean, and perhaps than the ocean.

Great rivers, in their course, are constantly receiving small ones into their channels. The Danube, for example, receives more than 200 brooks and rivulets. But, if we reckon only rivers of some consideration, we will find, that the Danube receives 30 or 31, the Wolga 32 or 33, the Don 5 or 6, the Nieper 19 or 20, the Duina 11 or 12. The Hoanho, in Asia, receives 34 or 35 rivers,

the Jenisca more than 60, the Oby an equal number, the Amour about 40, the Kian, or river of Nankin, 30, the Ganges more than 20, the Euphrates 10 or 11, &c. In Africa, the Senegal receives more than 20 rivers; the Nile receives none lower than 500 leagues from its mouth, the last which falls into it being the Moraba; and from this place to its source, it receives about 12 or 13. In America, the Amazons receives more than 60 considerable rivers, St. Lawrence, about 40, reckoning those which fall into the lakes, the Mississippi more than 40, the Plata above 50, &c.

Upon the surface of the earth, there are elevated countries which seem to be points of partition marked out by nature for the distribution of the waters. In Europe, one of these points is Mont Saint Godard, and its environs. Another point is the country situated between the provinces of Belozera and Wologda in Muscovy, from which many rivers descend, some into the White Sea, some into the Black, and others into the Caspian. In Asia, there are several points of partition, as the country of the Mogul Tartars, some of whose rivers run into the Sea of Nova Zembla, others into the Gulf of Linchidolin, others into the Sea of Corea, and others into that of China; and the Lesser Thibet, the rivers of which run into the Chinese Sea, into the Gulf of Bengal, the Gulf of Cambaia, and the Lake Aral. The province of Quito, in America, discharges its rivers into the South and North Seas, and into the Gulf of Mexico.

In the Old Continent, there are about 430 rivers which directly fall either into the Ocean, or into the Mediterranean and Black Seas. But, in the New Continent, we know of only 135 rivers which fall immediately into the sea. In this number I have reckoned none which are not as large as the river Somme in Picardy.

All these rivers transport, from the countries through which they pass, into the sea, great quantities of mineral and saline particles. The particles of salt, which dissolve in water, are easily carried down to the sea. Several philosophers, and particularly Halley, have alledged, that the saltness of the sea proceeds alone from the particles of salt transported by the rivers: others maintain, that this saltness was coeval with the sea itself, and that the salt was created to prevent the waters from corrupting. But the agitation of the sea by the winds and the tides is, I imagine, a cause equally powerful as the salt in preserving it against putrefaction; for, when barrelled up, it corrupts in a few days. And Boyle informs us of a navigator who was overtaken with a calm which lasted 13 days, and who assured him, that the water became so putrid, that, if the calm had continued much longer, the whole crew would have perished. (See Boyle, vol. iii. p. 222.) Sea-water is also impregnated with a bituminous oil, which renders it both unwholesome and disagreeable to the taste. The quantity of salt in sea-water is about a fortieth part, and it is nearly of an equal saltness at the surface and at the bottom, under the Line and at the Cape of Good Hope; though there are some particular places, as off the Mosambique coast, where it is more salt than in others. (See Boyle, vol. iii. p. 217.) It is likewise said to be less salt within the Arctic circle: but this phænomenon may proceed from the immense quantities of snow, and the large rivers which fall into these seas and from the proportional defect of evaporation.

However this matter stands, I believe, that the saltness of the ocean is not only occasioned by the many banks of salt at the bottom of the sea, and along the coasts, but likewise by the salts continually brought down by the rivers; that Halley was right in his conjecture that there was originally little or no salt in the sea, but that its saltness gradually augmented in proportion as salt was supplied by the rivers; that the degree of saltness is perpetually increasing; and, consequently, that, by computing the total quantity of salt carried down by the rivers, we might be enabled to discover the real age of the world. Mr. Boyle affirms, on the authority of divers and pearl fishers, that the water is colder in proportion to its depth; and that, at great depths, the cold becomes so excessive as to oblige them to come up much sooner than usual. But the weight of the water may be as much the cause of their uneasiness as the intenseness of the cold, especially when they descend 300 or 400 fathoms. Divers, however, seldom go deeper than 100 feet. The same author relates, that, in a voyage to the East Indies, when they arrived at the 35th degree of south latitude, they sounded to the depth of 400 fathoms, and when the lead, which weighed about 30 pounds, was drawn up, it had become as cold as ice. It is likewise a common practice at sea to sink the bottles several fathoms, in order to cool their wine; and, it is said, that the deeper the bottles are sunk, the wine becomes the cooler.

These facts would lead us to imagine, that the sea-water was salter at the bottom than at the surface. But they are opposed by facts of a contrary nature: experiments have been made with vessels which opened only at a certain depth, and the water was not found to be salter than that at the surface. There are even examples of the water at the bottom being fresher than at the surface. This phænomenon is exhibited in all those places where springs arise from the bottom of the sea, as near Goa, at Ormus, and in the sea of Naples, in which are many warm springs.

In other places, sulphureous springs and beds of bitumen have been discovered at the bottom of the sea; and, upon land, there are numerous springs of bitumen which run into the sea. At Barbadoes, there is a fountain of bitumen which runs from the rocks into the sea.

Bitumen and salt, then, are the principal ingredients in sea-water. But it is blended with many other substances; for its taste differs considerably in different parts of the ocean: besides, agitation and the heat of the sun change the natural taste of sea-water; and the different colours of different seas, and even of the same sea at different times, prove it to be mixed with many heterogeneous bodies, which are detached either from the bottom, or carried down by the rivers.

Most countries that are furnished with large rivers are subject to periodical inundations; and those rivers which have long courses overflow with the greatest regularity. Every body has heard of the inundations of the Nile, the waters of which, though spread over a large track of country, and at a great distance from the sea, preserve their sweetness and transparency. Strabo and other ancient authors tell us, that the Nile had seven mouths; but now only two which are navigable remain: a third canal, indeed, supplies the cisterns of Alexandria; and there is a fourth, which is still less considerable. As the cleaning of these canals has long been neglected, they are mostly in ruins. In these works, ancients employed annually a vast number of workmen and soldiers, who carried off the mud and sand which this river brings down in great quantities. The overflowing of the Nile is occasioned by the rains which fall in Ethiopia: they begin in April, and end not till September. During the first three months, the days are serene and beautiful; but the sun no sooner sets, than the rains begin, continue incessantly till sun-rising, and are commonly accompanied with thunder and lightning. The inundation in Egypt begins about the 17th of June; it generally takes 40 days in swelling, and as many in subsiding. The whole flat country of Egypt is overflowed: but the inundation is not now so great as in ancient times; for Herodotus affirms, that the Nile swelled 100 days, and required an equal time to subside. If this fact be true, the difference can be ascribed to no other causes but the gradual elevation of the land by the mud brought down and deposited, and the diminution in the height of the mountains from which this river derives its source. It is natural to think, that the height of the mountains is diminished; for the heavy rains that fall in these regions during one half of the year, bring down great quantities of sand and earth from the tops of the mountains into the valleys, from which they are transported by torrents into the channel of the Nile, and are partly deposited on the land by the inundations.

The Nile is not the only river that has regular and annual overflowings: the Pegu, which is equally regular in its inundations, has, from this circumstance, got the name of the *Indian Nile*. It overflows the country for 30 leagues beyond its banks, and, like the Nile, leaves great quantities of mud and slime, which enrich the ground so much, that it produces excellent pasture for cattle, and enables the inhabitants to export rice. (See Les Voyages d'Ovington, tom. ii. p. 290.) The Niger, or, which is the same thing, the upper part of the Senegal, overflows and covers the whole flat country of Nigritia. Its inundations, like those of the Nile, begin about the middle of June, and increase for 40 days. The Plata, in Brasil, overflows annually, and at the same time with the Nile. The Ganges, the Indus, the Euphrates, and some other rivers, produce annual inundations. But all rivers are not subject to periodical inundations: these proceed from a combination of causes, which, at the same time, augment the quantity of water, and diminish its velocity.

We formerly remarked, that the declivity of rivers gradually diminish till they arrive at the sea. But, in some places, the declivity is more sudden, and forms what is called *a cataract*, which is nothing more than an unusually rapid fall of the water. In the Rhine, for example, there are two cataracts, one at Bilefeld, and the other near Schafhouse. The Nile has several cataracts: two of the most remarkable fall from a great height, between two mountains. In the Wologda, in Muscovy, there are also two, near Ladoga. The Zaire, a river in Congo, commences with a large cataract, which falls from the top of a mountain. But the most celebrated cataract is that of the river Niagara in Canada: it falls, in a prodigious torrent, 156 feet of perpendicular height, and is a fourth part of a league in breadth. The vapour of the water rises to the clouds, is seen at the distance of five leagues, and, when the sun shines above it, exhibits a beautiful rainbow. Below this cataract, the whirlpools and commotions of the waters are so tremendous, as to render navigation impracticable for six miles; and immediately above the cataract, the river is much narrower than higher up. (See Phil. Trans. Abridg. vol. vi. part 2. p. 119.) Charlevoix describes it in the following manner:

'My first care, after my arrival, was to visit the noblest cascade, perhaps, in the world; but I presently found the Baron de la Hontan had committed such a mistake with respect to its height and figure, as to create a suspicion that he had never seen it. If, however, you measure its height by that of the three mountains you are obliged to climb to get at it, it does not fall much short of what the map of M. Deslisle makes it, that is, 600 feet. He has probably adopted this paradox, either on the faith of the Baron de la Hontan, or of Father Hennepin. But, after I arrived at the summit of the third mountain, I observed, that, in the space of three leagues, which I had to walk before I came to this piece of water, though you are sometimes obliged to ascend, you must yet descend still more; a circumstance to which travellers seem not to have sufficiently attended. As it is impossible to approach it but on one side, and consequently to see it,

'except in profile, it is no easy matter to measure its 'height with instruments. It has, however, been at- 'tempted by means of a pole tied to a long line, and, 'after many trials, it has been found to be only 115, or '120 feet high. But it is impossible to be sure that the 'pole has not been stopt by some projecting rock; for, 'though it was always drawn up wet, as well as the end 'of the line to which it was tied, this circumstance 'proves nothing, as the water which precipitates itself 'from the mountain, rises very high in foam. For my 'own part, after having examined it on all sides, where 'it could be viewed to the greatest advantage, I am in- 'clined to think that we cannot allow it to be less than 'a hundred and forty or fifty feet high.

'As to its figure, it resembles that of a horse-shoe, 'and is about 400 paces in circumference. It is divided 'into two, exactly in the middle, by a very narrow 'island, half a quarter of a league long. It is true, 'these two parts very soon unite; that on my side, and 'which I could have a side view of only, has several 'branches which project from the body of the cascade, 'but that which I viewed in front, appeared to me quite 'entire. The Baron de la Hontan mentions a torrent, 'coming from the west, which, if this author has not in- 'vented it, must certainly fall through some channel 'during the melting of the snows only.' (Tom. iii. p. 353.)

Three leagues from Albany, in the province of New York, there is a cataract of 50 feet perpendicular height, the vapour of which likewise gives rise to a rainbow. (See Phil. Trans. Abridg. vol. vi. part 2. p. 119.)

In every country where the number of men is too inconsiderable for forming and supporting polished societies, the surface of the earth is more unequal and rugged, and the channels of rivers are more extended, irregular, and often interrupted by cataracts. The Rhone and the Loire would require the operation of several ages before they became navigable. It is by confining and directing the waters, and clearing the bottoms of rivers, that they acquire a fixed and determinate course. In thinly inhabited regions, nature is always rude, and sometimes deformed.

Some rivers lose themselves in the sands, and others seem to precipitate into the bowels of the earth. The Guadalquivir in Spain, the river of Gottenburg in Sweden, and even the Rhine, disappear under ground. It is affirmed, that, in the west part of the Island of St. Domingo, there is a pretty high mountain, at the foot of which are several large caverns that receive the rivers and brooks; and the noise of their fall is heard at the distance of seven or eight leagues. (See Varen. Geogr. p. 43.) The number of rivers, however, which disappear in the earth, is very small; and they seem not to descend very deep. It is more probable, that, like the Rhine, they lose themselves by dividing and dispersing through a large surface of sand, which is very common with those small rivers that run through dry and sandy ground, of which there are many examples in Africa, Persia, Arabia, &c.

The rivers of the north carry down to the sea prodigious quantities of ice, which, by accumulating, form those enormous masses, so dangerous to the mariner. The straits of Waigat, which is frozen during the greatest part of the year, is most remarkable for these masses of ice, that are constantly brought into the straits by the river Oby. They attach themselves all along the coasts, and rise to great heights. The middle of the strait freezes last, and the ice, of course, does not rise so high as on each side. When the north wind ceases, and it blows in the direction of the straits, the ice begins to melt and to break in the middle; then large masses are detached and transported into the open sea. The wind, which blows during the whole winter from the north, over the frozen country of Nova Zembla, renders the regions watered by the Oby, and all Siberia, so cold, that, at Tobolski, in the 57th degree, there are no fruit trees, though at Stockholm in Sweden, and even in higher latitudes, they have fruit trees and leguminous plants. This difference proceeds not, as has been imagined, from the sea of Lapland being colder than that of the straits, nor from the country of Nova Zembla being colder than that of Lapland, but from this circumstance alone, that the Baltic and the sea of Bothnia soften the rigour of the north wind; whereas, in Siberia, there is nothing to check its activity. This solution is a result of experience. The cold is never so intense near the sea-coasts as in the interior parts of a country. There are plants which endure the open air all winter at London, which cannot be preserved at Paris: and Siberia, which is a vast continent, is, for this reason, colder than Sweden, which is almost surrounded with the sea.

Spitzbergen is the coldest country in the world: it runs as far as the 78th degree of north latitude, and is composed of small, pointed mountains. These mountains consist of gravel, and of flat stones, like gray slate, heaped upon one another. According to the accounts of voyagers, these hills are raised by the winds, and new ones appear every season. In this country no quadrupeds live but the rein-deer, which feeds upon moss. Beyond these hills, and above a league from the sea, the mast of a ship was lately found with a pully fixed to one end of it; from which circumstance, it has been concluded, that this is a new country, and that it was formerly covered with the sea: it is uninhabited and uninhabitable; for the hills have no consistence, but are loose and moveable; and a vapour proceeds from the earth, so cold and penetrating, as to preclude the possibility of

remaining any time upon this dreary and inhospitable land.

The whale-fishing vessels arrive at Spitzbergen in July, and depart from it about the middle of August. The ice permits them not to arrive sooner, or to remain longer. In these seas there are prodigious boards of ice, clear and shining as glass, and from 60 to 80 fathoms thick; and, in some places, the sea appears to be frozen to the bottom. (See Recueil des Voyages du Nord, tom. i. p. 154.)

The seas of North America are likewise much infested with ice, as in Ascension Bay, in Hudson's, Cumberland's, Davis's, and Frobisher's, straits, &c. We are assured by Robert Lade, that the mountains of Friesland are entirely covered with snow; and that the ice surrounds the coasts, and, like a bulwark, prevents all approach to them. 'It is remarkable,' says he, 'that, in 'this sea, we meet with islands of ice, more than half a 'league in circumference, exceedingly high, and descend 'from 70 to 80 fathoms deep. This ice, which is sweet, 'is perhaps originally formed in the rivers or straits of 'the adjacent lands, &c. These islands or mountains 'of ice are moveable, and, in storms, they follow the 'track of a ship, as if they were d n after her by a 'a rope. Some of them rise so high above water, that 'they surmount the tops of the tallest masts, &c.' (See Lade's Voyages.)

In the voyages collected for the use of the Dutch East India Company, we have the following account of the ice of Nova Zembla: 'At Cape Troost, the weather was 'so foggy, as to oblige us to moor our vessel to a bank 'of ice, which was 36 fathoms below, and 16 above the 'surface of the water. On the 10th of August, the ice 'began to separate, and to float; we then remarked, that 'the mass to which our vessel had been moored, touched 'the bottom; for, though the others were all in motion, 'and struck against it, and against each other, it re-'mained immoveable. We were now afraid of being 'frozen in, or dashed in pieces; we therefore endea-'voured to escape from this latitude, though the vessel, 'in her course, was obliged to push through the ice, 'which made a great noise round us for a considerable 'distance: we at last anchored along another board of 'ice, where we remained that night.

'During the first watch, the ice began to split, with 'an inconceivable noise. The ship's head kept so 'strongly to the current in which the ice-boards floated 'that we were obliged to veer the cable in order to get 'her off. We counted above 400 blocks of ice, which 'sank 10 fathoms below the water, and appeared to rise 'about 2 fathoms above it.

'We then moored the vessel to another block of ice, 'which was immersed below the surface about six f,a 'thoms. At a little distance from this station we per-'ceived a large bank, which was pointed like a cone, and 'reached to the bottom of the sea; we approached it, 'and found it to be 20 fathoms below, and about 12 'above the surface of the water.

'On the 11th, we sailed up to another bank, which 'was 18 fathoms below the surface, and 10 fathoms 'above it.

'The Dutch, on the 21st, advanced a great way be-'tween the boards of ice, and anchored during the 'night. Next morning they retired, and moored to a 'bank which was 18 fathoms below, and 10 above the 'water. They climbed to the top, and remarked, as a 'singular phænomenon, that it was covered with earth, 'and that they found there about 40 eggs. Its colour 'was a fine azure blue, and totally different from that of 'the other masses. This circumstance gave rise to 'various speculations; some imagining it to be an effect 'of the ice, and others thought the whole mass was of 'frozen earth.' (See Trosieme Voyage des Hollandois par le Nord, tom. i. p. 46.)

Wafer met with many floating pieces of ice, off Terra del Fuego, which were so large that he at first imagined them to be islands; some of them, he remarks, appeared to be a league or two in length, and the largest of them seemed to rise 400 or 500 feet above the surface of the earth.

All these boards of ice, as I have remarked in the 6th Article, are transported from the rivers into the sea. Those in the Sea of Nova Zembla and in the Straits of Waigat, come from the Oby, and, perhaps, from the Jenisca, and other great rivers in Siberia and Tartary; those of Hudson's Straits, from Ascension-bay, into which many rivers in North America empty themselves; and those of Terra del Fuego, from the southern continent. If fewer of them appear in the northern coasts of Lapland than in those of Siberia and Waigat's Straits, it is because all the Lapland rivers fall into the Gulf of Bothnia, and none of them into the North Sea. They may likewise be formed in straits, where the tides rise higher than in the open sea; and, consequently, where the boards of ice which float on the surface may accumulate and produce masses or banks of several fathoms high. But, with regard to those which rise to the height of four or five hundred feet, it appears, that they can no where be produced but near very elevated coasts; and I imagine, that when the snows which cover these coasts melt, the water runs down upon the boards of ice, and, by freezing anew, gradually augments their size, till they arrive at this amazing height; that, in a warm summer, the action of the winds, the agitation of the sea, and perhaps their own weight, may detach them from the coasts, and set them adrift; and that they may even be transported into temperate climates before they are entirely dissolved.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XI.

Of Seas and Lakes.

THE dry land is every where surrounded by the ocean: it penetrates, sometimes by large openings, and sometimes by small straits, into the interior parts of different countries, and forms mediterranean seas, some of which are affected by the motion of the tides, and others not. We shall, in this article, trace the ocean through all its windings; and, at the same time, give an enumeration of the mediterranean seas, which we shall endeavour to distinguish from what are called bays or gulfs, and lakes.

The sea that washes the western coasts of France, forms a gulf between Spain and Brittany. This gulf is, by navigators, called the Bay of Biscay. It is very open, and advances farthest into the land between Bayonne and St. Sebastian. It likewise advances considerably at Rochelle and Rochefort. This bay begins at Cape Ortegal, and terminates at Brest, where a strait commences between the south point of Brittany and the Lizard Point. This strait, which is at first pretty wide, forms a small bay on the coast of Normandy, the most advanced point of which is at Auranche. It continues pretty large till it arrives at the channel of Calais, where it is very narrow; it then suddenly enlarges, and terminates between the Texel and the coast of Norwich. At the Texel, it forms a small shallow mediterranean called *Zuidersee*, and several large gaps or advances, the waters of which are not of a considerable depth.

After this, the ocean forms a large bay called the *German Sea*, which commences at the northernmost point of Scotland, and runs along the east coast of Britain the length of Norwich; and from thence to the Texel, along the coasts of Holland and Germany, of Jutland and Norway, as far as Bergen. This bay may even be considered as a mediterranean; for the Orkney islands nearly shut up its mouth, and seem, by their direction, to be a continuation of the mountains of Norway. It forms a large strait, which commences at the south point of Norway, and continues pretty broad to the island of Zetland, where it suddenly contracts, and forms, between the coasts of Sweden and the islands of Denmark and Jutland, four small straits; after which, it widens to a small bay, the most advanced point of which is at Lubec; from thence, to the south extremity of Sweden, it continues pretty broad; then it enlarges more and more, and forms the Baltic, which is a mediterranean sea, extending, from south to north, near 300 leagues, if the Gulf of Bothnia, which is a continuation of it, be comprehended. In the Baltic are two bays, that of Livonia, the most advanced point of which is near Mittau and Riga, and that of Finland, which is a branch of the Baltic, extending between Livonia and Finland to Petersburgh, and communicating with Lake Ladoga, and even with Lake Onega, which joins the White Sea by means of the river Onega. The whole body of water which forms the Baltic, the Gulfs of Bothnia, of Finland, and of Livonia, ought to be regarded as an immense lake, supported by a great number of rivers, as the Oder, the Vistula, the Niemen, the Droine in Germany and Poland; by other rivers in Livonia and Finland, by others still more considerable which come from Lapland, as the Tornea, the Calis, the Lula, the Pithea, the Uma; and by several from Sweden. These rivers, which, in general, are large, amount to more than 40, including those which fall into them, and cannot fail to convey a quantity of water sufficient to supply the Baltic. Besides, there are no tides in the Baltic, and its water has very little saltness: and if the situation of the land, and the number of lakes and marshes in Finland and Sweden, which are contiguous to the Baltic, be taken into consideration, we shall be inclined to regard it not as a sea, but as a great lake formed by the waters which it receives from the adjacent countries, and which have forced for themselves a passage near Denmark into the ocean, into which, according to the relation of voyagers, it still continues to run.

From the commencement of the bay which goes by the name of the German Sea, and which terminates beyond Bergen, the ocean follows the coasts of Norway, Swedish Lapland, North Lapland, and Muscovite Lapland, at the eastern part of which it forms a large strait, and gives rise to the mediterranean called the White Sea, which may also be considered as a great lake; for it receives twelve or thirteen large rivers, which are more than sufficient to supply it with water; and its water contains but little salt. Besides, it very nearly, in several places, communicates with the Baltic; and it has an evident commu-

nication with the Gulf of Finland; for, in ascending the river Onega, we arrive at a lake of the same name, which is joined by two rivers to Lake Ladoga; and this last communicates by a large branch with the Gulf of Finland; and there are, in Swedish Lapland, several places from which the waters run almost indifferently either into the White Sea, or into the Gulfs of Bothnia and of Finland. This whole country is full of lakes and marshes, and, therefore, it seems probable, that the Baltic and White Seas were the receptacles of its waters, and that, in time, they discharged themselves into the German and Frozen Seas.

On leaving the White Sea, and coasting the island of Candenos, and the north of Russia, the ocean advances a small arm into the land at the mouth of the river Petzora. This arm, which is about 40 leagues in length, by 8 or 10 in breadth, may rather be regarded as a collection of water formed by the river, than as a gulf of the sea; for it also contains very little salt. In this place the land runs out in a promontory terminated by the small islands of Maurice and of Orange; and between this promontory and the neighbouring land to the south of Waigat's Strait, there is a bay of about 30 leagues long, which belongs to the ocean, and is not formed by rivers. This is succeeded by Waigat's Strait, which lies nearly under the 70th degree of north latitude; it is not above 8 or 10 leagues in length, and it communicates with the sea which washes the north coasts of Siberia. As the strait is blocked up with ice during the greatest part of the year, it is very difficult to penetrate into the sea beyond it. This passage has been tried in vain by many navigators; and those who succeeded have not given us exact charts of the sea, which they call the Pacific Sea. By the most recent charts, and, by the best globes, it appears, that this sea may be only a mediterranean, having no connection with the great sea of Tartary; for it seems to be shut up and bounded to the south by the country of the Samoides, which is now well known, and which extends from the Straits of Waigat to the mouth of the river Jenisca. To the east, it is bounded by Jelmorland; to the west by Nova Zembla; and, though we know not the extent of this sea to the north and north-east, as the land seems not to be interrupted, it is probable that the Pacific Sea is only a mediterranean; and that it is bounded by land, and has no communication on that side with the ocean. What establishes this fact is, that, in departing from the Straits of Waigat, the whole west and north coasts of Nova Zembla, the length of Cape Desire, have been traversed; that, from this Cape, the coasts of Nova Zembla have been traced to a small bay about the 75th degree, where some Dutchmen passed a dreadful winter in 1596; and that, beyond this gulf, the land of Jelmorland was discovered in 1664, which is separated from Nova Zembla only by a few leagues of land; so that the only land unknown is a small spot near this little bay just now described; and this spot exceeds not, perhaps, 30 leagues in length. If, therefore, the Pacific Sea joins with the eastern ocean, it must be by means of this small bay, which is the only way by which this mediterranean can have any communication with the eastern ocean. And, even on the supposition that such a communication existed, as this bay lies in the 75th degree of latitude, it would be necessary, to gain this open sea, to keep five degrees farther north. It is apparent, therefore, that, in attempting a north passage to China, it is better to sail beyond Nova Zembla to the 77th or 78th degree, where the sea is more open and clearer of ice, than to persist in passing the frozen Straits of Waigat, when it is even uncertain whether the sea beyond them has any communication with the eastern ocean.

The coast has been traced from Nova Zembla and Jelmorland to the mouth of the Chotanga, which is about the 73d degree; beyond which an unknown coast extends about 200 leagues. We only know, from the Russians who travelled by land into these climates, that the country is not interrupted; and, in their charts, the rivers are delineated, and they called the inhabitants *Populi Palati*. This interval of unknown coast extends from the mouth of the Chotanga to that of Kauvoina, in the 66th degree of latitude. The bay of Linchidolin, in which the Russians fish whales, advances farthest into the land at the mouth of the Len, which is a considerable river. This bay is very open, and pertains to the sea of Tartary.

From the mouth of the Len, the northern coast of Tartary runs about 500 leagues eastward to a peninsula inhabited by a people called Schelates. It is the most northern part of Tartary, and lies under the 72d degree of latitude. In this extent of 500 leagues, the ocean forms neither bays nor arms; only from the peninsula of the Schelates, to the mouth of the Korvinea, there is a considerable elbow or projection. This point is the eastern extremity of the north coast of the Old Continent, and Cape North in Lapland is the western extremity. Thus, we have of northern coast, from Cape North in Lapland, to the extremity of the country of the Schelates, an extent of 1700 leagues, including the sinuosities of bays; and it measures about 1100 leagues in a straight line.

Let us next take a survey of the eastern coasts of the Ancient Continent. We shall begin at the extreme point of the country of the Schelates, and descend towards the equator. The ocean first makes a turn between the country of the Schelates and that of the Tschutschi, which last projects considerably into the sea. To the south of this country, there is a small open bay, called the bay of Suctoikret. This bay is succeeded by another, which advances, like an arm, about 40 or 50

leagues into the land of Kamtschatka: after which the ocean flows in, by a narrow strait, full of small islands, between the southern point of Kamtschatka and the northern point of the land of Jesso, and forms a large mediterranean, which we shall now decribe in detail. It consists of the sea of Kamtschatka, in which there is a considerable island, called the island of *Amour*. An arm of this sea runs north-east. But, both this arm and the sea of Kamtschatka may, at least in part, be formed by the rivers which flow into it from the lands of Kamtschatka, and those of Tartary. However this matter stands, the sea of Kamtschatka communicates, by a very long strait, with the sea of Corea, which is another part of this mediterranean; and the whole to gether, extending more than 600 leagues in length, is bounded, on the west and north, by the lands of Corea and Tartary; and, on the east and south, by those of Kamtschatka, Jesso, and Japan, without having any other communication with the ocean than by the strait between Kamtschatka and Jesso; for it is uncertain whether the communication between Japan and the land of Jesso, though laid down in some charts, has a real existence; and, even supposing it did exist, the sea of Kamtschatka and that of Corea would still be regarded as forming together a great mediterranean, separated on all sides from the ocean, and not as a bay; for it communicates not with the ocean by its southern strait, but with the Chinese Sea, which is rather a mediterranean than a bay.

In the preceding article, it was remarked, that the sea had a constant motion from east to west; and that, consequently, the great Pacific Ocean is making continual efforts against the eastern coasts. An accurate examination of the globe will confirm the conclusions we have drawn from this observation; for it appears, that, from Kamtschatka to New Britain, discovered by Dampier in 1700, and which lies in the 4th or 5th degree of south latitude, the ocean has encroached on these coasts to the extent of 400 leagues; and, of course, that the eastern bounds of the Old Continent stretch not so far as they did formerly; for, it is remarkable, that New Britain and Kamtschatka, which are the most advanced lands to the east, lie under the same meridian. Besides, all countries extend farthest from north to south. Kamtschatka makes a point of about 160 leagues from north to south, and this point, the eastern coast of which is washed by the Pacific Ocean, and the other by the mediterranean above described, is divided from north to south by a chain of mountains. The lands of Japan and of Jesso form another territory between the ocean and the sea of Corea, extending from north to south more than 400 leagues; and the direction of the chains of mountains in Jesso and Japan must be from north to south; because, in this direction, they extend 400 leagues; but, from west to east, they exceed not 50 or 60. Thus, Kamtschatka, Jesso, and the eastern part of Japan, ought to be considered as contiguous lands, lying in a direction from north to south: and, following the same direction, we find, after the point of Cape Ava in Japan, the island of Barnevelt, and three other islands, situated in a line from north to south, and extending about 100 leagues. We next meet with three islands, called Callanos, and, after these, the Ladrone islands, to the number of 14 or 15, all stretching in a line from north to south, the whole occupying a space of 300 leagues in length; and the broadest part of these islands, from east to west, exceeds not 8 leagues. From these facts, I am led to conclude, that Kamtschatka, Jesso, the east part of Japan, the islands of Barnevelt, the Callanos, and the Ladrones, are a continuation of the same chain of mountains, and the remains of an ancient country, which has been gradually corroded and covered with the sea. All these countries appear to be nothing but mountains, of which the islands are the peaks or points, the low-lands being occupied by the ocean. Hence, what is related in the *Lettres Edifiantes* must be true; and, in fact, a number of islands, called the New Philippines, has been discovered in the very situation in which P. Gobien supposed them to lie: and it cannot be doubted, that the most easterly of these New Philippines are a continuation of the chain of mountains which compose the Ladrones; for these eastern islands, to the number of eleven, lie in a line from north to the south, extending in length more than 200 leagues; and, in breadth, the largest of them exceeds not eight leagues.

But these conjectures may seem too bold, on account of the great distances between the islands in the neighbourhood of Cape Ava, of Japan, and of the Callanos, between these islands and the Ladrones, and between the Ladrones and the New Philippines, the first interval being about 160 leagues, the second 50 or 60, and the third near 120. But it ought to be considered, that chains of mountains often extend much farther below the waters of the ocean; and that these intervals are nothing when compared to the extent of land, from south to north, in these islands or mountains, which, beginning at the interior part of Kamtschatka, is more than 1100 leagues. But, though this idea concerning the quantity of land gained by the ocean on the eastern parts of the Old Continent, and the continuation of the mountains, should be rejected, still it must be acknowledged, that Kamtschatka, Jesso, Japan, the islands of Rois, Formosa, Vaif, Basha, Babuyane, Lucca, Mindanao, Gilolo, &c. and, lastly, New Guinea, which extends to New Britain, and is situated under the same meridian as Kamtschatka, form a stretch of country of more than 2200 leagues, with small interruptions, the greatest of which exceeds not, perhaps, 20 leagues; so that the ocean has scooped out an immense bay from the interior

parts of the eastern continent, which begins at Kamtschatka, and terminates at New Britain. This bay is interspersed with numerous islands, and has all the appearances of being gained from the land. It is, therefore, probable, that the ocean, by its constant motion from east to west, has gradually gained this great tract of country from the continent, and has formed several mediterraneans, as those of Kamtschatka, of Corea, of China, and perhaps the whole Indian Archipelago; for the land and water are so blended together in this region, that it evidently appears to have been a large country destroyed by inundations, of which only the eminences and mountainous parts are now to be seen, the lower grounds being entirely concealed under the waters of the ocean. This hypothesis is farther confirmed by the shallowness of the sea, and the figures of the innumerable islands, which seem to be nothing but the tops of mountains.

If we take a more particular survey of these seas, we shall find, that the northern part of the Chinese Sea forms itself into a great bay, which begins at the island of Fungma, and terminates at the frontiers of the province of Pekin, about 50 leagues from the capital of the Chinese empire. The most advanced and narrowest part of this bay is called the Gulf of Changi. It is probable that this gulf, and part of the Sea of China, are encroachments of the ocean, and that the islands above described are the most elevated parts of the ancient country. Farther south are the bays of Tonquin and Siam, in the neighbourhood of which is the peninsula of Malacca, consisting of a long chain of mountains, that run from north to south; and the Andaman Islands, which form another chain of mountains, in the same direction, seem to be only a continuation of those of Sumatra.

The ocean afterwards forms the great bay of Bengal; where it may be remarked, that the land of the peninsula of Indus makes a concave curve, towards the east, nearly resembling the great bay of the eastern continent, which seems to have been produced by the same cause, namely, the motion of the sea from east to west. In this peninsula are the mountains of Gates, which extend from north to south; and the island of Ceylon appears to have been separated from this part of the continent.

The Maldiva Islands are only another chain of mountains stretching from north to south. Then follows the Arabian Gulf, which sends off four branches or arms; the two largest are on the west coast, and the two smallest on the east. The first arm on the east coast is the bay of Cambaia, which extends not above 50 or 60 leagues; but it receives two considerable rivers, the Tapta and the Baroche or Mehi. The second arm or bay on the same coast is remarkable for the rapidity and height of its tides, which alternately advance and retreat more than 50 leagues. Into this bay fall several rivers, as the Indus, the Padar, &c. which have brought down sand and mud in such quantities as to elevate the bottom of the bay, and reduce it nearly to a perfect level. It is owing to this circumstance that the tides extend to so great a distance. The first arm on the west coast is the Persic Gulf, which advances into the land above 250 leagues; and the second is the Red Sea, which, reckoning from the island of Socotora, extends above 680 leagues. From the straits of Ormuz and of Babelmandel, these two arms should be considered as mediterranean seas: they are both, indeed, subjected, to a flux and reflux; but this circumstance is occasioned by their vicinity to the equator, where the tides rise higher than in other climates. Besides, they are both very long and narrow. The motion of the tides is more rapid in the Red Sea than in the Persic Gulf; because the former is nearly three times as long, and equally narrow, as the latter; neither does it receive any river capable of resisting the tide: but the Persic Gulf receives three large rivers at its most advanced extremity. It is apparent, that the Red Sea has been formed by an irruption of the ocean; for the situation and similarity in the direction of the coasts on each side of the straits of Babelmandel show, that this passage has been cut by the waters.

At the extremity of the Red Sea lies that famous strip of land called the Isthmus of Suez, which is a barrier to the junction of the Red Sea with the Mediterranean. In the preceding article, I gave the reasons which render it probable that the Red Sea is higher than the Mediterranean, and that, if the isthmus were cut, an inundation and increase of the latter would be the consequence. It may here be added, that, though the superior elevation of the Red Sea should not be allowed, yet it is incontestible, that there are no tides in the Mediterranean near the mouths of the Nile. It is equally certain, that the tides in the Red Sea rise several feet; and this circumstance alone, on the supposition of the removal of the Isthmus, would occasion a great influx of water from the Red Sea into the Mediterranean. Besides, Varenius, in his Geography, remarks, 'Oceanus Germanicus, qui 'est Atlantici pars, inter Frisiam et Hollandiam se ef- 'fundens, efficit sinum, qui, et si parvus sit respectu 'celebrium sinuum maris, tamen et ipse dicitur mare, 'alluitque Hollandiæ emporium celeberrimum, Amste- 'lodamum. Non procul inde abest lacus Harlemensis, 'qui etiam mare Harlemense dicitur. Hujus altitudo 'non est minor altitudine sinus illius Belgici, quem 'diximus, et mittit ramum ad urbem Leidam, ubi in 'varias fossas divaricatur. Quoniam itaque nec lacus 'hic, neque sinus ille Hollandici maris inundant adja- 'centes agros, (de naturali constitutione loquor, non 'ubi tempestatibus urgentur, propter quas aggeres facti 'sunt); patet inde, quod non sint altiores quam agri 'Hollandiæ. At vero Oceanum Germanicum esse al- 'tiorem quam terras hasce, experti sunt Leidenses, cum

'suscepissent fossam seu alveum ex urbe sua ad Oceani 'Germanici littora, prope Cattorum vicum perducere, '(distantia est duorum milliarium) ut, recepto per al-'veum hunc mari, possent navigationem instituere in 'Oceanum Germanicum, et hinc in varias terræ regiones. 'Verumenimvero, cum magnam jam alvei portam per-'fecissent, desistere coacti sunt, quoniam tum demum 'per observationem cognitum est, Oceani Germanici 'aquam esse altiorem quam agrum inter Leidam et littus 'Oceani istius: unde locus ille, ubi fodere desierunt, 'dicitur *Het malle Gat*. Oceanus itaque Germanicus 'est aliquantum altior quam sinus ille Hollandicus,' &c. (p. 100.) As the German Ocean, therefore, is higher than the sea of Holland, nothing prevents us from believing that the Red Sea may be higher than the Mediterranean. Herodotus and Diodorus Siculus mention a canal of communication between the Nile, the Mediterranean, and the Red Sea: and M. de l'Isle, in 1704, published a map, where he has laid down the termination of a canal in the east branch of the Nile, which he imagined to be a part of the canal which formerly joined that river to the Red Sea. (See Mem. de l'Acad. des Sciences, année 1704.) We meet with the same opinion in a book entitled *Connoissance de l'Ancien Monde;* where the author, copying Diodorus Siculus, informs us, that this canal was begun by Necho king of Egypt; that Darius king of Persia continued the work; that it was finished by Ptolemy II. who conducted it to the city of Arsinoe; and that it could be shut and opened at pleasure. I pretend not to deny these facts; but, I confess, they appear to be doubtful. I suspect, that the violence and height of the tides in the Red Sea, would necessarily communicate their influence to the waters of the canal: at least, it would require great precaution to prevent inundations, and to keep the canal in proper repair. Though we are told by historians that this canal was begun and finished, they are silent as to its duration; and the remains of it, which are pretended still to exist, are perhaps the only parts of it that ever were executed. This branch of the ocean has been denominated the *Red Sea*, because, wherever there are madrepores or corals at the bottom, the water of it has the appearance of being red. The following description of it is given in the *Histoire Generale des Voyages:* 'Before leaving the Red 'Sea, D. Juan inquired into the causes which induced 'the ancients to give it this appellation: he recol-'lected, that Pliny had delivered several opinions con-'cerning the origin of this name. Some derived it from 'a king of that country called *Erythros*, which, in the 'Greek language, signifies *Red:* others imagined that 'the red colour was occasioned by the reflection of the 'sun from the surface of the water; and others affirmed 'that the water itself was red. The Portuguese, who 'had made several voyages in that sea, alledged, that 'the whole coast of Arabia was remarkably red; and 'that the dust and sand carried into the sea by the winds, 'tinged the water with the same colour.

'Dom Juan, who examined the nature of the water 'and of the coasts, through their whole extent, with the 'most scrupulous attention, assures us, that the waters 'of this sea have no peculiarity in their colour; and that 'the dust and sand, not being red themselves, could not 'possibly communicate this colour to the water. "The 'land on each side," he observes, "is generally brown; 'in some places, it is black, and, in others, white. At 'Suaquem, the coasts of which the Portuguese never 'visited, there are three mountains striped with red; 'but they consist of hard rocks, and the neighbouring 'ground is of the usual colour."

'The truth is, that this sea is all of the same uniform 'colour, of which any man may satisfy himself by draw-'ing water from different parts. But, it must be ac-'knowledged, that, in some places, it appears, by acci-'dent, to be red, and, in others, green and white. This 'phænomenon admits of the following explication. 'From Suaquem to Kossir, which is an extent of 136 'leagues, the sea is filled with banks and rocks of coral; 'they are so called from their resembling coral in form 'and colour so exactly, that it is difficult to perceive the 'distinction: there are two kinds of them, the one is 'white, and the other extremely red. In many places, 'they are covered with a kind of gum, or viscid sub-'stance, of a green colour, and sometimes of a deep 'orange. Now, the water of this sea is so transparent, 'that the bottom is visible at the depth of twenty fa-'thoms, especially from Suaquem to the extremity of the 'gulf; and hence the water assumes, in appearance, the 'colour of the bodies which it covers. When, for ex-'ample, the rocks are overlaid with a green gum, the 'water above them appears to be green; when the 'bottom is sand alone, the superincumbent water seems 'to be white; and, when the rocks are covered with 'coral, the water above them appears to be reddish. 'But, as the rocks of this colour are more frequent than 'the green or white, Dom Juan concludes, that the 'Arabic Gulf has, from this circumstance, obtained the 'name of the Red Sea. He was the more satisfied with 'this discovery, because the method he employed in the 'investigation of it left no room for hesitation or doubt. 'In such places as were not deep enough to allow his 'vessel to sail, he fastened pinks opposite to the rocks; 'and the sailors were enabled to execute his orders, at 'more than half a league from the rocks, without being 'immersed above the middle of their bodies. In those 'places where the water appeared red, the greatest part 'of the stones and pebbles they brought up were of the 'same colour; where the water appeared green, the 'stones were green also; and where the water appeared 'white, the bottom was a pure white sand.' (Tom. i. p. 198.)

From the entrance to the Red Sea, at Cape Gardafu, to the Cape of Good Hope, the direction of the coast is pretty equal, and the sea forms no bays of any note. There is, indeed, a small scoop on the coast of Melinda, which, if the Island of Madagascar were united to the continent, might be considered as a part of a large bay. This island, it is true, though separated by the straits of Mozambique, appears to have formerly belonged to the continent; for, in this strait, there are high sands of great extent, especially on the Madagascar coast, which render the open part of it very narrow.

From the Cape of Good Hope to Cape Negro, on the west coast of Africa, the land lies in the same direction; and the whole of it seems to be a chain of mountains. It is, at least, a very elevated country, and, though more than 500 leagues in length, it is furnished with no rivers of any consideration, except one or two, which are known no farther than their mouths. But the coast, above Cape Negro, makes a large curve; and the land, along this curve, appears to be lower than that of the rest of Africa. It is watered by several great rivers, the largest of which are the Coanza and the Zaire. From Cape Negro to Cape Gonsalvez, are the mouths of 24 considerable rivers; and the space between these two capes, reckoning along the shore, is about 420 leagues. We would be tempted to think, that the ocean has encroached on these low lands of Africa, not by its natural motion from east to west, which could have no influence in producing this effect, but by the facility with which it might have undermined and surmounted them. From Cape Gonsalvez to Cape Trois-pointes, the ocean forms an open bay, which presents nothing remarkable, except a very advanced point nearly in the middle of it, called *Cape Formosa*. It likewise contains, in the southern part of it, the islands of Fernandpo, St. Thomas, and Prince's Island. These islands appear to be a continuation of a chain of mountains situated between Rie del Rey, and the river Jamoer. From Cape Trois-pointes to Cape Palmas, the ocean runs a little in upon the land; and from Cape Palmas to Cape Tagrin, there is nothing worthy of remark. But, beyond Cape Tagrin, there is a small bay in the country of Sierra-Leona; and a little farther, there is another, in which are situated the islands of Bisagas. We afterwards meet with Cape Verd, which projects far into the sea, and of which the islands of the same name appear to be a continuation; or, rather, they seem to be a continuation of Cape Blanc, which is a more elevated country, and stretches still farther into the ocean. We next come to a mountainous and dry coast, which commences at Cape Blanc, and terminates at Cape Bajador. The Canary islands seem to be a continuation of these mountains. Lastly, between Africa and Portugal, is a large open bay, in the middle of which are the celebrated Straits of Gibratar. The ocean pours its waters, with great rapidity, through this strait into the Mediterranean. This sea runs into the interior parts of the land near 900 leagues, and gives rise to many objects worthy of remark. 1st. It has no perceptible tides, except in the Gulf of Venice; and a small flux and reflux have been alledged to take place at Marseilles and on the coast of Tripoli. 2d. It contains many large islands, as Sicily, Sardinia, Corsica, Cyprus, Majorca, &c. and Italy, which is one of the most extensive peninsulas in the world. It is likewise adorned with a rich Archipelago, or rather, it is from the Mediterranean Archipelago that all other collections of islands have acquired that appellation. But this Archipelago appears to belong more properly to the Black Sea than to the Mediterranean; and it is probable, that the country of Greece was partly covered with the Black Sea, which runs into the sea of Marmora, and from that into the Mediterranean.

It has been alledged, that a double current runs through the Straits of Gibraltar; one superior, which carries the waters from the ocean into the Mediterranean, and another inferior, which carries the waters from the Mediterranean back to the ocean. But this notion is false, and contrary to the known laws of hydrostatics. Opposite currents have been ascribed to several other straits, as the Bosphorus, the straits of Sunda, &c.; and Marsilli has related many experiments tending to prove the existence of a superior and inferior current in the Bosphorus. These experiments, however, must have been fallacious; for such a phænomenon is repugnant to the nature and motion of fluids. Besides, Greaves, in his *Pyramidographie*, has demonstrated, by accurate experiments, that there are no opposite currents in the Bosphorus. Marsilli and others may have been deceived by the regorging of the water near the shores, which takes place in the Bosphorus, in the straits of Gibraltar and in all rapid rivers, and which often produces a motion opposite to that of the principal current.

Let us now briefly run over the coasts of the New Continent. We shall begin with Cape Hold-with-hope, which is situated in the 73d degree of North Latitude. This is the most northerly point of land in New Greenland, and is distant from Cape North in Lapland about 160 or 180 leagues. From this cape the coast of Greenland might be traced to the polar circle, where the ocean forms a large strait between Iceland and Greenland. Some maintain, that this country in the neighbourhood of Iceland is not the Ancient Greenland, formerly possessed by the Danes as a dependent province. Its inhabitants were civilized Christians, who had bishops, churches, and a number of towns proportioned to their trade. The Danes had a communication with them as easy, and as frequent, as the Spaniards with the Canary islands. There still exists, it is said, laws and regulations with regard to the government of this province, and these not of a very ancient date. However, without

forming any conjectures how this country came to be absolutely lost, we find not in New Greenland the least vestige of what is here related. They are mere savages. They have no buildings. There is not a word in their language that has the smallest affinity to the Danish tongue; and there is not a single circumstance from which we can infer it to be the same country. It is even almost a desert, and is covered with snow and ice the greatest part of the year. But, as these lands are of vast extent, and, as the coasts have been little frequented by modern navigators, they may have missed the place occupied by the descendants of these polished people; or the increase of the ice in this sea may now, perhaps, hinder all access to them. If, however, maps can be trusted the whole coast of this country is known. It forms a large peninsula, at the extremity of which are the two straits of Frobisher and of Friesland, where the cold is excessive, although they are not farther north than the Orkneys, that is, about 60 degrees.

Between the west coast of Greenland, and that of Labrador, the ocean forms a gulf, and then a large mediterranean, which is the coldest of all seas, and its coasts are little known. In pursuing this gulf, we meet with Davis's Strait, which leads to the Christian Sea, which last terminates in Baffin's Bay, through which there appears to be an outlet into Hudson's Bay. The strait of Cumberland, which, like that of Davis, may lead into the Christian Sea, is more narrow, and more subject to be frozen. Hudson's Strait, though much farther south, is also frozen for some part of the year. And it is remarkable, that the tides are very high in those seas and straits, although no tides take place in the inland seas of Europe, as the Baltic and Mediterranean. This difference seems to be occasioned by the motion of the sea from east to west, which produces high tides in straits opposite to the current of the waters, or whose mouths open to the east. But, in those of Europe, which open to the west, there are no tides. The ocean, by its general movement, rushes into the former, but flies from the latter; and this is the reason why the tides are so violent in the seas of China, Corea, and Kamschatka.

In sailing down Hudson's Bay towards Labrador, there is a narrow opening, 30 leagues of which Davis traversed in 1586, and traded with the inhabitants. But no attempts have hitherto been made to discover the whole of this arm of the sea. We know nothing of the neighbouring country, but the land of the Esquimaux. Fort Pon-chartrin is the only settlement, and the most northerly part of this country; and it is separated from the island of Newfoundland by the small strait of Belleisle, whi h is little frequented. As the eastern coast of Newfoundland has the same direction with that of Labrador, this island appears to have been formerly a part of the continent, in the same manner as Isle-Royal seems to have been detached from Acadia. The bottoms of the great bank, and of the lesser banks on which the cod-fishery is carried on, are not deep; but, as they shelve a great way under water, they produce violent currents. Between Cape Breton and Newfoundland, there is a pretty large strait, which is the mouth of a small mediterranean, called the *Gulf of St. Lawrence*. It sends off a branch, which extends a considerable way into the country, and appears to be only the mouth of the river of that name. In this arm of the sea the tides are very perceptible; and, even at Quebec, which is farther up the country, the waters rise several feet. Leaving the Gulf of St. Lawrence, and following the coast of Acadia, we meet with a small gulf called *Boston-Bay*, which is of a square figure, and advances a little way only into the land. But, before we pursue this coast any farther, it is worthy of remark, that, from Newfoundland to Guiana, the ocean forms an immense bay, that runs in upon the land as far as Florida, which is more than 500 leagues. This bay is similar to that of the Old Continent above described, where the ocean, after forming a large gulf between Kamtschatka and New Britain, gives rise to a great mediterranean, which comprehends the sea of Kamtschatka, of Corea, of China, &c. In the same manner, in the New Continent, the ocean, after forming a large gulf between Newfoundland and Guiana, gives rise to a great mediterranean, extending from the Antilles to Mexico; which confirms what we have advanced concerning the motion of the sea from east to west. For it appears that the ocean has gained as much territory on the east coast of America as on the east coast of Asia. Besides, these great gulfs in each continent lie under the same degrees of latitude, and are nearly of equal extent. Such singular relations, it would appear, must have been produced by the same cause

If we examine the position of the Antilles, beginning with the island of Trinidad, which is the southmost, it is impossible to doubt but that Trinidad, Tobago, the Granades, St. Vincent, Martinico, Marygalant, Antigua, Barbadoes, and all the adjacent isles, once formed a chain of mountains, which extended from south to north, like Newfoundland and the country of the Esquimaux. Farther, the direction of the Antilles, from east to west, if we begin with Barbadoes, and pass on to St. Bartholomy, Porto-Rico, St. Domingo, and Cuba, is nearly the same with the coasts of Cape Breton, Acadia, and New England. All these islands lie so contiguous, that they may be regarded as a continued belt of land, and as the most elevated parts of a country now occupied by the sea. Most of them are nothing but the tops of mountains; and the sea between them and the continent is a true mediterranean, in which the tides are not much more perceptible than in our Mediterranean,

although the straits between the islands are directly opposed to the motion of the sea from east to west, which should contribute to raise the tides in the gulf of Mexico. But, as this gulf is very broad, the waters elevated by the tide when expanded over a large surface, hardly produce any sensible change upon the coast of Louisiana and several other places.

Both the Old and New Continents, therefore, appear to have been encroached upon by the ocean in the same latitudes. Both are furnished with a great mediterranean, and a vast number of islands, which likewise lie nearly in the same latitudes. The only difference is, that the Old Continent, being much larger than the New, has a mediterranean on its west coast, to which the New Continent has nothing analogous. But both seem to have undergone similar revolutions. These revolutions are greatest near their middle parts, or between the tropics, where the motion of the sea is most violent.

The coasts of Guiana, from the mouth of the river Oronoko to that of the Amazons, exhibit nothing remarkable. But the Amazons, which is the largest river in the universe, forms a considerable sheet of water near Coropa, before it discharges itself into the sea by the two mouths which surround the island of Caviana. From the mouth of the Amazons to Cape St. Roche, the river runs almost straight east; from Cape St. Roche to Cape St. Augustine it runs south, and from Cape St. Augustine to the bay of All Saints, it runs westward in such a manner that this part of Brasil projects considerably into the ocean, which is directly opposite to a similar projection of the African coast. The bay of All Saints is a small arm of the sea, which advances about 50 leagues into the land, and is much frequented by navigators. From this bay to Cape St. Thomas, the coast runs straight south, and from thence, in a south-west direction, to the mouth of the Plata, where an arm of the sea projects about 100 leagues into the land. From this river, to the southern extremity of America, the ocean forms a large bay, which is terminated by Falkland Island, Cape Assumption, and other lands bordering on Terra del Fuego. At the bottom of this bay is the Strait of Magellan, the longest in the universe, and where the tides rise very high. Beyond this is the Strait of La Maire, which is much shorter, and, lastly, Cape Horn, which is the south point of America.

On the subject of points or head-lands, it is remarkable, that they all regard the south, and that most of them are cut by straits which run from east to west. The point of South America regards the Arctic Pole, and it is cut by the Strait of Magellan. That of Greenland, which likewise has a southern aspect, is cut from east to west by the Strait of Frobisher. That of Africa regards also the south, and, beyond the Cape of Good Hope, are banks and shoals which appear to have been separated from it. That of the peninsula of India is cut by the strait between it and the island of Ceylon; and, like all others, projects southward. These are facts; but we are unable to give any explication of them.

From Terra del Fuego, all along the west coast of South America, the ocean makes considerable advances into the land; and this coast seems to follow exactly the direction of the high mountains which traverse this part of the continent from south to north, from the Equator to the Arctic Pole. Near the Line, the ocean forms a large bay, extending from Cape St. François to Panama, that famous isthmus, which, like that of Suez, hinders the junction of the two seas. If these two necks of land were removed, both the Old and the New Continent would be divided into two distinct portions. From Panama to California, there occurs nothing worthy of remark. Between the peninsula of California and New Mexico, is a long arm of the ocean, called the *Vermilion Sea*, which is more than 200 leagues long. In fine, the west coast of California has been traced to the 43d degree of latitude. It was in this latitude that Drake, who first discovered the land to the north of California, and which he called *New Albion*, was obliged, by the rigour of the cold, to change his course, and to anchor in a small bay which bears his name; so that the countries beyond the 43d or 44th degree, in this part of the globe, are as little known as those of North America beyond the 48th degree, which is inhabited by the Moozemleki, and the 51st, which is inhabited by the Assiniboils. The territory of the former savages extends much farther west than that of the latter. All beyond, for 1000 leagues in length, and as much in breadth, is totally unknown, unless the Russians, as they pretend, have made some discoveries, by departing from Kamtschatka, and visiting the eastern coasts of North America.

The ocean, then, surrounds the whole globe, without interruption, and we may sail round it by taking our departure from the south point of America. But we are still uncertain whether the ocean surrounds, in the same manner, the north part of the globe; and all the navigators, who have attempted to go from Europe to China by the north-east or north-west, have equally failed in their enterprizes.

Lakes differ from mediterraneans; the former derive no water from the ocean; on the contrary, when they communicate with seas, they are constantly discharging water into them. Thus the Black Sea, which some geographers have regarded as a branch of the Mediterranean, and, of course, as an appendage of the ocean, is only a lake; because, in place of receiving any supplies from the Mediterranean, its waters run with rapidity through the Bosphorus, into the lake called the Sea of Marmora, and from thence through the straits of the Dardanelles into the Grecian Sea. The Black Sea is about 250 leagues long, and 100 broad: it receives a number of large rivers, as the Danube, the Nieper, the

Don, the Boh, the Donjec, &c. The Don, which unites with the Donjec, before it arrives at the Black Sea, forms a lake called the *Palus Meotis*, which is more than 100 leagues in length, and from 20 to 25 in breadth. The Sea of Marmora, which is below the Black Sea, is a lake smaller than the Palus Meotis, being not above 50 leagues long, and 8 or 9 broad.

It is related by some of the ancients, and particularly by Diodorus Siculns, that the Euxine, or Black Sea, was originally a great river or lake, and had no communication with the Greek Sea; but that its waters were, in the course of time, so greatly augmented by the rivers which fall into it, that they forced a passage, first by the islands of Cyanea, and then by the Hellespont. This opinion has great probability on its side; and, I think, it is no difficult matter to explain how the operation was effected: For, supposing the bottom of the Black Sea to have been formerly much lower than it is now, the mud and sand carried down by the rivers would gradually raise it, till the surface of the water was elevated above that of the land, and then the water would necessarily find a passage for itself: and, as the rivers continue still to transport sand and earth, and as, at the same time, the quantity of water in the rivers diminishes in proportion as the mountains from which they spring are lowered, it may happen, in the course of ages, that the Bosphorus will again be filled up. But, as effects of this nature depend on many causes, we must content ourselves with simple conjectures. M. Tournefort, on the authority of the ancients, says, that the Black Sea, which receives the waters of a great part of Europe and Asia, after being considerably augmented, opened to itself a passage by the Bosphorus, and either formed the Mediterranean, or increased its waters to such a degree, that they forced a passage to the ocean through the Straits of Gribraltar; and that, the island of Atalantis, mentioned by Plato, was, on this occasion, totally overflowed. This notion cannot be supported; for the ocean runs into the Mediterranean, and not the Mediterranean into the ocean. Besides, M. Tournefort has not combined two essential facts, though he has mentioned both of them. The first is, that the Black Sea receives 9 or 10 rivers, each of which furnishes more water than is discharged by the Bosphorus; and the second, that the Mediterranean does not receive more water from rivers than the Black Sea, though it be seven or eight times larger; and what it receives from the Bosphorus is not the tenth part of what falls into the Black Sea. How, therefore, could this tenth part of the water that falls into a small sea, produce not only a larger sea, but augment its waters to such a degree as would enable it to break down the Isthmus of Gibraltar, and overwhelm an island of greater extent than the whole of Europe? It is easy to perceive that M. Tournefort has not sufficiently considered this matter. The Mediterranean derives from the ocean at least ten times the quantity of water it receives from the Black Sea; for the narrowest part of the Bosphorus exceeds not 800 paces, while that of the Straits of Gibraltar is more than 5000; and, supposing the velocities of both to be equal, still the water in the Straits of Gibraltar is by much the deepest.

M. Tournefort, who ridicules Polybius for predicting that the Bosphorus will in time be filled up, has not attended sufficiently to circumstances, otherwise he would not have pronounced the impossibility of such an event. Must not the Black Sea, which constantly receives the sand and mud of eight or ten large rivers, gradually fill up? Must not the winds and the natural current of the waters continually transport part of these matters into the Bosphorus? It is, therefore, extremely probable, that, in the course of ages, the Bosphorus will be choaked up, when the quantity of water discharged by the rivers into the Black Sea shall be greatly diminished. Now, the rivers are diminishing daily, because the mountains, which collect the dews, and give rise to the rivers, are continually decreasing.

The Black Sea receives more water from rivers than the Mediterranean; and M. Tournefort observes, on this subject, 'That the greatest rivers in Europe fall into 'this sea by means of the Danube, into which are dis- 'charged the rivers of Suabia, Franconia, Bavaria, Aus- 'tria, Hungary, Moravia, Carinthia, Croatia, Bothnia, 'Servia, Transylvania, and Wallachia. The rivers of 'Black Russia and of Podolia fall likewise into the 'same sea by means of the Niester; those of the south- 'ern and eastern parts of Poland, of the northern part 'of Muscovy, and of the country of the Cossacks, fall 'into it, either by the Nieper or Boristhenes; the Tanais 'and the Copa empty themselves into the Black Sea by 'the Cimmerian Bosphorus; the rivers of Mingrelia, 'the principal of which is the Phasis, also discharge 'their contents into this sea, and likewise the Casalmac, 'the Sangaris, and other rivers of Asia Minor which 'take a northern course: but the discharge through the 'Thracian Bosphorus, which is the only outlet from the 'Black Sea, is not comparable to that of any one of these 'great rivers.' (See Voyage du Levant de Tournefort, vol. ii. p. 123.)

All these facts demonstrate the great quantity of water carried off by evaporation; and it is owing to this circumstance that the ocean constantly runs into the Mediterranean by the Straits of Gibraltar. It is difficult to ascertain the quantity of water received by any sea; it requires an exact knowledge of the breadth, depth, and velocity of all the rivers that fall into it, of their augmentation and diminution in different seasons of the year, and of the quantity which the sea loses by evaporation. This last is the most difficult to determine; for supposing evaporation to be proportioned to the surfaces, it will be greater in a warm than in a cold climate.

Besides, water mixed with salt and bitumen evaporates more slowly than fresh water; a sea subject to great agitations evaporates more quickly than a calm sea; and a difference in the depth has also some effect. In fine, so many particulars are included in the theory of evaporation, that it is not possible to make an exact estimation of its quantity.

The water of the Black Sea is less clear and less salt than that of the ocean. There are no islands in it; and its tempests are more violent and more dangerous than those of the ocean; because its waters, being extended in a basin which has but an inconsiderable outlet, move, when agitated, in a kind of whirlpools, which beat upon all sides of a vessel with an insupportable violence. (See Voyages de Chardin, p. 142.)

After the Black Sea, the greatest lake in the world is the Caspian Sea, which extends from south to north about 300 leagues, and its mean breadth exceeds not 50. This lake receives the Wolga, besides several other considerable rivers, as the Kur, the Faie, and the Gempo. But, what is singular, it receives not one river from the east coast; the country on that side is a sandy desert, which remained, till lately, altogether unknown. The Czar Peter I. sent engineers to make a chart of the Caspian Sea. It had been represented as round by former geographers; but it is very long and very narrow. Its eastern coast, and the neighbouring country, were entirely unknown; even Lake Aral, which is about 100 leagues east of the Caspian, was either not known to exist, or was considered as a part of this sea. Thus, before the discoveries of the Czar, there was in this region an unknown country of 300 leagues in length, and 100 or 150 in breadth. Lake Aral is nearly oblong, and about 90 or 100 leagues long, and 50 or 60 broad. It receives the Sideroias and the Oxus, two large rivers; but, like the Caspian, it has no outlet for discharging its waters; and, as the Caspian receives no rivers from the east, Lake Aral, on the contrary, receives none from the west. Hence, it is presumable, that these two formerly constituted but one lake; and the rivers being gradually choaked up, the country between them would necessarily be covered with sand. There are some small islands in the Caspian; and its waters are much fresher than those of the ocean. Storms, in this sea, are exceedingly dangerous; and it affords not navigation to large vessels, on account of shoals, sand-banks, and rocks concealed under the surface. 'The largest vessels 'employed on the Caspian,' says Pietro della Valle, 'along the coasts of the province of Mazanda in Persia, 'where stands the town of Ferhabad, although they be 'called *ships*, are no better than our tartanes: their sides 'are high; they draw little water, and are flat-bottomed. 'They are built of this construction, not only because 'this sea is shallow near the coasts, but because it is full 'of shoals and sand-banks; so that no other vessels 'could be used with safety. I was surprized to see no 'fishing carried on at Ferhabad, except salmons at the 'mouth of the river, a bad kind of sturgeon, and other 'fresh water fishes of no value. I attributed this to 'their ignorance of navigation and of the art of fishing, 'till I was informed by the Cham of Esterabad, that this 'sea, at the distance of 20 or 30 miles from the shore, is 'so shallow, that nets could not be used with advantage; 'and that the same reason accounted for the construction 'of their vessels, which carry no cannon, because 'the Caspian is not infested with pirates.' (Tom. iii. p. 235.)

Struys, Avril, and others, affirm, that, in the neighbourhood of Kilan, there are two gulfs, which swallow up the waters of the Caspian, and carry them, by subterranean passages, into the Persic Gulf. De Fer, and other geographers, have laid down these gulfs in their maps, though we are assured by the Czar's envoys, that they have no existence. (See Mem. de l'Acad. des Sciences, année 1721.) The fact, with regard to the willow leaves found on the Persic Gulf, and which are alledged by the same authors to be transported from the Caspian Sea, because no willows grow near the Persic Gulf, appears to be equally improbable, as the subterraneous passages, which Gemelli Careri, as well as the Russians, maintain to be altogether imaginary. Besides, the Caspian is about a third less than the Black Sea, which last also receives more water by rivers; evaporation, therefore, is alone sufficient to carry off all its adventitious waters, without the assistance of imaginary gulfs, or subterraneous passages.

There are lakes, or seas, which neither receive nor discharge rivers; there are others which both receive and discharge, and others which only receive. The Caspian, Lake Aral, and the Dead Sea, are of the last kind: in Asia Minor, there is a small lake of the same species: there is another still larger in Persia, upon which the city of Marago is situated: it is of an oval figure, and about 10 or 12 leagues long, and 6 or 7 broad: it receives the Tauris, which is not a very considerable river. If to these we add a small lake of the same nature in Greece, 12 or 15 leagues from Lepanto, we have an enumeration of all the known lakes in Asia which belong to this species. In Europe, there is not a single one of any consideration. There are several small lakes of this kind in Africa, as those which receive the rivers Ghir, Zez, Touguedout, and Tafilet. These four lakes lie at no great distance from one another, and are situated on the frontiers of Barbary, near the desert of Zaara. There is another in the province of Kovar, which receives the river that runs through the country of Berdoa. In North America, which abounds with lakes, there are none of this kind, except two small collections of water formed by brooks, the one near Guatimapo, and the other some leagues from Realnuevo, both in Mexico.

But in Peru there are two contiguous lakes, one of which, Lake Titicaca, is very large, and receives a river which rises near Cusco; but it gives rise to no river. There is a small lake in Tucuman, which receives the river Salta; another, in the same country, of greater extent, receives the Santiago; and three or four between Tucuman and Chili.

Those lakes, which neither receive nor give rise to any river, are more numerous than the kind just mentioned. They are a species of swamps, which collect the rain water; or, they may originate from subterraneous waters that issue in the form of springs in low grounds, from which there is no fall to carry them off. Those rivers that overflow may also leave stagnating waters upon the land, which remain a considerable time, and are occasionally recruited by subsequent inundations. Salt lakes may sometimes be produced by inundations from the sea, as that at Harlem, and several others, in Holland, to which no other origin can be ascribed. The sea, likewise, by abandoning certain lands, may have left lakes in the low grounds of particular countries, and which continue to be maintained by the rains. Of this kind, there are small lakes in Europe, as in Ireland, in Jutland, in Italy, in the country of the Grisons, in Poland, in Muscovy, in Finland, and in Greece: but all these are of little consideration. In Asia, near the Euphrates, in the desert of Irac, there is one above 15 leagues long; another in Persia, nearly of the same extent, upon which are situated the towns of Kelat, Tetuan, Vasfan, and Van; a small one in Chorasan, near Ferrior; another in Independent Tartary, called *Lake Levi;* two in Muscovite Tartary; one in Cochinchina; and, in fine, a pretty large one not far from Nankin. This last, however, communicates with the neighbouring sea by a canal of considerable extent. In Africa, there is a small lake of this species in the kingdom of Morocco; another near Alexandria, which appears to have been left by the sea; another, 8 or 10 leagues long, formed by the rain-water, in the desert of Azarad, about the 30th degree of latitude; another, still larger, upon which is situated the town of Gaoga, under the 27th degree; another, but much smaller, near the town of Kanum, under the 30th degree; one near the mouth of the river Gambia; several others in Congo, about the 2d or 3d degree of south latitude; two others in the country of the Caffres; one of them, called *Lake Rufumbo,* is not very extensive; and the other, which lies in the province of Arbuta, is perhaps the largest of this kind, being about 25 leagues long, and 7 or 8 broad: there is likewise one of these lakes near the east coast of Madagascar, about the 29th degree of south latitude.

In America there is one of these lakes situated in the middle of the peninsula of Florida, which has an island called *Serrope* in its centre. The lake near the town of Mexico, which is round, and about 10 leagues in diameter, belongs likewise to this species. There is another still more extensive in New Spain, about 25 leagues from the eastern coast of the Bay of Campeachy; and another, of smaller dimensions, in the same country, near the coast of the South Sea. Some travellers have affirmed, that, in the interior parts of Guiana, there is a very large lake of this species, which they call *Golden Lake,* or *Lake Parima;* and they have given marvellous accounts of the riches of the neighbouring country, and of the great quantities of gold dust found in this lake, which they alledge to be more than 400 leagues in length, and above 125 in breadth: no river, it is said, either enters into or issues from it. Though this lake be laid down in several maps, its existence is still problematical.

But the most common and the most extensive lakes are those which both receive and give rise to rivers: as they are exceedingly numerous, I shall only mention the largest, or the most remarkable of them. Beginning with Europe, we have, in Switzerland, the Lake of Geneva, that of Constance, &c. In Hungary, Lake Balaton, and another, of equal extent, in Livonia, which separates this province from Russia; Lake Lapwert in Finland, which is very long, and divides into several branches, and Lake Oula, which is of a circular figure: in Muscovy, Lake Ladoga, which is more than 25 leagues long, and above 12 broad; Lake Onega, which is equally long, but not so broad; Lake Ilmen; Lake Belozero, which is one of the sources of the Wolga; Lake Iwan-Osero, which is one of the sources of the Don; and two other lakes, from which the river Vitzogda derives its origin: in Lapland, the lake from which issues the river Kimi; another, much larger, and situated near the coast of Wardhus; and several others of less note, which give rise to the rivers Lula, Pitha, and Uma: in Norway, two lakes nearly of the same dimensions with those of Lapland: in Sweden, Lake Vener, which is as large as Lake Meller, upon which Stockholm is situated; and two less considerable, one near Elvedal, and the other near Lincopin.

In Siberia, and in Muscovite and Independent Tartary, there are a great number of these lakes, of which the principal are, the great lake Baraba, which is more than 100 leagues long, and the waters of which fall into the Irtis; the great lake Estraguel, the source of the Irtis; several lesser ones, the sources of the Jenisca; the great lake Kita, the source of the Oby; another great lake, the source of the Angara; Lake Baical, which is more than 70 leagues long, and is formed by the river Angara; and Lake Pehu, the source of the Urack, &c. In China and Chinese Tartary, we have Lake Dalai, the source of the great river Argus, which falls into the Amour; the lake of the Three Mountains, the source of the river Helum, which falls likewise into the the Amour; the lakes of Cinhal, Cokmor, and Sorama,

the sources of the river Hoanho; two large lakes in the neighbourhood of Nankin, &c. In Tonquin is the Guadag, a lake of considerable magnitude. In India, we have Lake Chiamat, which is the source of the river Laquia, and lies near the sources of the Ava, the Longenu, &c. This lake is more than 50 leagues long, and about 40 broad. The source of the Ganges is another lake; and one near Cashmire gives rise to the Indus, &c.

In Africa, there are Lake Cayar, and two or three others, near the mouth of the Senegal; Lake Guarda, and Lake Sigismus, which, together, make a triangular lake of 100 leagues long, and 75 broad, and contain a considerable island. It is in this lake that the Niger loses its name, and at its exit, assumes that of *Senegal*. In ascending towards the course of this river, we meet with another pretty large lake called *Bournou*, where the Niger again changes its name; for the river that falls into this lake is called *Gombaru*. At the sources of the Nile in Ethiopia, is the great lake Gambia, which is above 50 leagues long. On the coast of Guinea are also several lakes, which appear to have been originally formed by the sea; and there are few others in Africa of any note.

North America is the country of lakes. The most extensive of them are, Lake Superior, which is about 125 leagues long, and 50 broad; Lake Huron, which is near 100 leagues in length, and about 40 in breadth; Lake Illionois, which, comprehending the bay of Puants, is nearly as extensive as Lake Huron; Lake Erie and Lake Ontario, which, together, exceed 80 leagues in length, by 20 or 25 in breadth; Lake Mistasin, to the north of Quebec, is about 50 leagues long; Lake Champlain, to the south of Quebec, is nearly of equal length; Lake Alemipigon, and Lake Christinaux, both to the north of Lake Superior, are likewise considerable; the Lake of the Assiniboils contains several islands, and is more than 75 leagues long: besides the Mexican Gulf, there are two considerable lakes in that country; that called Nicaragua, in the province of the same name, is about 70 leagues in length.

Lastly, in South America, there is a small lake, the source of the Maragnon. A more extensive one gives rise to the river Paraguay: there are, besides Lake Titicares, the waters of which fall into the river Plata, two lesser ones, which discharge their waters into the same river; and some inconsiderable ones in the interior parts of Chili.

All lakes that give rise to rivers, and all those which occur in the course of rivers, or which border upon and discharge their waters into rivers, are not salt. Almost all those, on the contrary, which receive rivers, but give rise to none, are salt. This circumstance seems to favour the opinion, that the saltness of the sea is occasioned by salts brought down from the land by the rivers; for we find salt does not evaporate; and, of course, all that is transported by the rivers remains in the sea: although the water of rivers appears to be fresh, it is well known, that it contains a small quantity of salt, which, in the course of ages, might accumulate to such a degree as would be sufficient to produce the present saltness of the sea, which must be continually augmenting. It is in this manner, I presume, that the Caspian, Lake Aral, and the Black Sea, have become salt. With regard to those seas, which, like marshes, or swamps, neither receive nor discharge rivers, they are either salt or fresh according to their origin. Those in the neighbourhoood of the sea are commonly salt; and those at a distance from it are fresh; because the former have originated from inundations of the sea, and the latter from fresh fountains.

The waters of the Dead Sea contain a great deal of the bitumen of Judea, which is nothing but asphaltes; and, accordingly, this sea is often termed the *Asphaltic Lake*. The neighbouring land is impregnated with this bitumen: and many have imagined, that, like the Lake Avernus, no fishes could live in it, and that birds were suffocated in attempting to fly over it. But such dismal effects are produced by neither of these lakes; for both of them contain fishes, the birds fly over them in safety, and men bathe in them with impunity.

It is said, that, in Bohemia, there is a lake, which has holes in it so deep, that they cannot be sounded, and that, from these holes, there issue violent winds which sweep over all Bohemia, and, in winter, raise into the air masses of ice of more than 100 pounds weight. (See Act. Leips. anno 1682, p. 246.) We are likewise told of a petrifying lake in Iceland; and Lake Neagh in Ireland possesses the same quality. But these petrifications are, doubtless, nothing but incrustations similar to those produced by the waters at Arcueil.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XII.

Of the Tides.

WATER, like other fluids, naturally descends from the higher to the lower grounds, if not hindered by some interposed obstacle; and, after, it has occupied the lowest situation, it remains smooth and tranquil, unless disturbed by some foreign cause. All the waters of the ocean are collected in the lowest places upon the surface of the earth; and hence the motions of the sea must proceed from external causes. The chief motion is that of the tides, which rise and fall alternately, and from which results a general and perpetual motion, in all seas, from east to west. These two motions have an invariable relation to the motions of the moon. During the full and new moons, this motion from east to west is most remarkable, as well as that of the tides, which ebb and flow, upon most coasts, every $6\frac{1}{2}$ hours. It is always high tide when the moon arrives at the meridian, either above or below the horizon of the place; and it is always ebb or low tide when the moon is at the greatest distance from the meridian, or when it rises and sets. The motion from east to west is perpetual; because, when the tide is rising, the whole ocean moves from east to west, and pushes westward an immense body of water; and the ebbing, or reflux, appears only to be owing to the smaller quantity of water which is then impelled towards the west. The flux, therefore, ought rather to be regarded as a swelling, and the reflux as the subsiding of the waters, which, in place of disturbing the motion from east to west, is the cause that produces and renders it perpetual; though this motion, for the reason already mentioned, is greater during the flux than the reflux.

This motion is attended with the following circumstances: 1st. It is more sensible at the full and new moon than at the quadratures; it is likewise more violent in spring and autumn than in any other season; and it is weakest at the solstices. This phænomenon is occasioned by the combined attractions of the moon and sun. 2d. The direction and quantity of this motion is often varied by the winds, especially such as blow constantly from the same quarter. Great rivers, in like manner, by discharging their water into the sea, produce currents which often extend several leagues, and are strongest when the direction of the wind corresponds with the general motion. Of this an example is afforded in the Pacific Ocean, where the motion from east to west is constant, and very perceptible. 3d. It is worthy remark, that, when one part of a fluid is moved, the motion is communicated to the whole. During the tides, therefore, a great part of the ocean is sensibly put in motion; and, consequently, the whole ocean, from surface to bottom, is moved at the same time.

To render this more clear let us attend to the causes which produce the tides. We formerly remarked, that the moon acted upon the earth by a force which some call attraction, and others gravity. This force penetrates the whole globe, is exactly proportioned to the quantity of matter, and decreases as the squares of the distances increase. Let us next examine what effects this force must produce upon the waters, when the moon comes to the meridian of any place. The surface of the water immediately under the moon is then nearer that planet than any other part of the earth; of course, that part of the sea must be elevated towards the moon, and the summit of this eminence must be opposite to the moon's centre. To produce this eminence, the waters upon the surface, as well as those at the bottom, contribute their share, in proportion to their distances from the moon, which acts upon them in the inverse ratio of the squares of their distances. Thus the surface of this part of the sea is first elevated; the surface of the adjacent parts is likewise elevated, but in a smaller degree; and the waters at the bottom of all these parts are raised by the same cause. Hence, as the whole portion of water under the moon is raised, the waters at a distance, upon which attraction is exerted, must necessarily rush forward with precipitation to supply the place of those which are elevated, or drawn towards the moon. It is in this manner that the flux, or high tide, is produced, which is more or less sensible on different coasts, and which agitates the sea not only at the surface, but at the greatest depths. The reflux, or ebb, is a consequence of the natural disposition of the water, which, when no longer acted upon by the moon, subsides, and returns ito occupy those shores from which it had been forced to retire by a foreign power. The same effect is produced when the

moon arrives at the antipode, or opposite meridian, but for a different reason. In the first case, the waters rise, because they are nearer the moon than any other part of the globe; and in the second, they rise, because the moon is at the greatest distance from them. It is easy to perceive that the effect must be the same; for the waters here being less attracted than those of the opposite hemisphere, they will necessarily recede, and form an eminence, the highest point of which will be where the attraction is least, that is, in the meridian opposite to the moon's station, or to the place where she was thirteen hours before. When the moon comes to the horizon, the tide is ebb, and the sea is in its natural state of equilibrium. But, when she is in the opposite meridian, this equilibrium cannot exist; for the waters, at the place opposite to the moon, being then at their great distance from her, they are less attracted than the rest of the globe; and hence their relative gravity, by which they are constantly kept in equilibrium, pushes them towards the point opposite to the moon, in order to preserve this equilibrium. Thus, in both cases, when the moon is in the meridian of a place, or in the opposite meridian, the waters must be elevated nearly to the same height; and, consequently, they must ebb or flow back when the moon is in the horizon, either at her rising or setting. A motion, such as we have described, necessarily agitates the whole mass of the ocean, from its surface to its bottom; and as the bottom is less affected by winds than the surface, the motion produced in the former by the tides, is more regular and uniform.

From this alternate ebbing and flowing, there results, as already remarked, a constant motion of the sea from east to west; for the moon, which is the cause of the tides, moves from east to west, and by acting successively, in this direction, she draws the waters after her. This motion is most perceptible in straits. At the Straits of Magellan, for example, the tides rise nearly 20 feet, and they continue at this height six hours; but the reflux, or ebbing, lasts only two hours, and the waters run to the west, (see Narborough's Voyages.) This incontestibly proves, that the reflux is not equal to the flux, and that, from both, there results a motion to the west, which is stronger during the flux than the reflux. It is for this reason, that, in open seas, at great distances from land, the tides are only rendered perceptible by this general current of the waters from east to west.

The tides are much higher between the tropics than in any other part of the ocean. They likewise rise higher in places that stretch from east to west, in long and narrow bays, and upon coasts which are interrupted with islands and promontories. The highest known tides take place at one of the mouths of the Indus, where they rise 30 feet perpendicular. They have also a remarkable elevation at Malaya in the Straits of Sunda, in the Red Sea, in Nelson's Bay, at the mouth of the river St. Lawrence, upon the coasts of China and Japan, at Panama, in the Gulf of Bengal, &c.

The sea's motion, from east to west, is most observable in particular places. Voyagers have often remarked it in sailing from India to Madagascar and Africa. It moves also with considerable force in the Pacific Ocean, and between the Moluccas and Brazil. But it is most violent in straits. The waters are carried from east to west, through the Straits of Magellan, for example, with such rapidity, that their motion is perceptible, at a great distance, in the Atlantic Ocean. It was this circumstance, it is said, that made Magellan conjecture that a strait existed by which there was a communication with the two seas. In the straits formed by the Manillas, in the channels between the Maldiva islands, and in the Gulf of Mexico, between Cuba and Jucatan, there is a constant current from east to west. This motion, in the Gulf of Paria, is so violent, that its strait is called the *Dragon's Mouth*. It is likewise violent in the sea of Canada, in that of Tartary, and in Waigat's straits, through which it forces enormous masses of ice into the northern seas. The Pacific Ocean runs from east to west through the straits of Japan; the Sea of Japan runs towards China; and the Indian Ocean runs westward through the straits of Java, and other islands of India. It is therefore evident, that the sea has a general and uniform motion from east to west; and it is certain that the Atlantic runs towards America, and that the Pacific Ocean flies from it, as is apparent at Cape Current between Lima and Panama. (See Varen. Geogr. p. 119.)

In fine, the tides rise and fall alternately in six hours and a half upon most coasts, though they happen at different hours, according to the climate, and the position of particular lands. Thus the coasts of the sea are perpetually beat by the waves; and each tide carries off from the higher grounds small quantities of matter, and deposits them, at a distance, on the bottom of the ocean. In the same manner, each tide carries in, and deposits upon low coasts, sand, shells, and other sea-bodies, which gradually form horizontal strata, and give rise to downs, and little hills, similar to other hills, both in figure and internal structure. Thus the sea is constantly encroaching upon high coasts, and losing ground upon those that are low; and these effects are produced by the tides, and by violent winds.

To give an idea of the violent effects of a stormy sea against a high coast, I shall relate a fact attested by an eye-witness, a person worthy of the highest credit. In the largest of the Orkney Islands, there are coasts composed of solid rock, above 200 feet high, and nearly perpendicular to the surface of the water. The tides, as is usual in islands and promontories, rise very high at this place. But, when a violent wind concurs with the flow of the tide, the agitation of the waters is so great,

that they often rise above these rocks, and fall down in the form of rain. Nay, to this amazing height, gravel, and stones as large as a man's fist, are raised from the foot of the rocks.

I myself saw, in the port of Leghorn, where the sea is much more tranquil, a tempest in December 1731, which obliged the mariners to cut off the masts of their vessels, that were driven, by the violence of the wind, from their anchors in the road. The waters of the sea surmounted fortifications of a great height; and, as I was upon one of the most advanced works, before I could reach the town, I was more drenched with sea-water than I could have been by the heaviest rain.

These examples may convey a notion of the violence with which the sea acts against particular coasts. [We are told by Shaw, in his Travels, that in many parts on the coast of Syria and Phœnicia, the rocks had been cut, by the ancients, into troughs of two or three yards long, and broad in proportion, for the purpose of making salt by evaporation. But, notwithstanding the hardness of the rocks, these troughs are now almost totally obliterated by the agitation of the waves.] This constant agitation gradually wears, corrodes, excavates, and diminishes the quantity of the land. All these materials are transported and deposited in places where the sea is more tranquil. In the time of storms, the water is foul and muddy, by the admixture of matters detached from the coasts and from the bottom of the sea. These bodies, which are very various, and carried from great distances, are thrown upon the low shores, especially after tempests, as ambergris on the west of Ireland, yellow amber upon the coasts of Pomerania, cocoas upon the coast of India, &c. and sometimes pumice, and other singular stones. On this occasion, we may quote a passage from the New Voyages to the islands of America. 'When at St. Domingo,' says 'the author, I was presented, among other things, with 'some light stones, brought in by the sea in high south 'winds. Some of them were two feet and a half long, 18 'inches broad, and about a foot thick; and yet they 'weighed not above five pounds. They were as white as 'snow, harder than pumice, of a fine grain, and appeared 'not to be porous. When, however, they were thrown into 'water, they rebounded, like a foot-ball thrown against 'the ground. It was difficult to force them under water 'with the hand. I inclosed two of these stones with 'thin boards, and found that they bore 160 pounds 'without sinking. They served my negro for a shallop 'on which he diverted himself in sailing about the quay.' (Tom. i. p. 260.) This stone must have been a pumice of a close fine grain, which had been transported by the sea from the neighbourhood of some volcano, in the same manner as ambergris, cocoas, common pumice, the seeds of plants, reeds, &c. are transported. It is chiefly on the coasts of Ireland and of Scotland that observations of this kind have been made. The sea, by its general motion from east to west, ought to carry to America the productions of our coasts; and it must be by the operation of some irregular movements, that the productions of the East and West Indies, and of the northern regions, are brought upon our coasts. The winds are probably the cause of these effects. In open seas, and at great distances from land, large portions of the water have been seen totally covered with pumice-stones. They could only come from volcanos in islands, or on the continent; and they have probably been transported to the open seas by currents. Before the south part of America was discovered, and when it was not believed that the Indian ocean had any communication with ours, appearances of this kind first gave rise to the idea that such a communication was not impossible.

The alternate motion of the tides, and the uniform motion of the sea from east to west, exhibit different appearances in different climates, according to the various indentations in the land, and the height of the coasts. In some places the motion from east to west is not perceptible; at others, it moves in a contrary direction, as on the coast of Guinea. But these contrary motions are occasioned by the winds, by the position of the land, by the waters of great rivers, and by the disposition of the bottom of the sea. All these causes produce currents, which often change the direction of the general movement. But, as this motion from east to west is the greatest, most general, and constant, it ought to produce the most signal effects; and upon the whole, the sea must gradually gain ground on the west, and lose it on the east; and although, upon coasts where the west wind blows during the greatest part of the year, as in France and Britain, the sea may gain land on the east; yet these exceptions destroy not the effect of the general cause.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XIII.

Of Inequalities in the Bottom of the Sea, and of Currents.

THE coasts of the sea may be divided into three kinds: 1. High coasts composed of hard rocks, commonly perpendicular, and of a considerable elevation, rising sometimes to the height of 700 or 800 feet. 2. Low coasts, of which some are almost level with the surface of the water, and others have a small elevation, and are often bordered with rocks nearly of a level with the water, which give rise to breakers, and render the approach of ships exceedingly dangerous. 3. Downs, or coasts formed by sand, either accumulated by the sea, or brought down and deposited by rivers: these downs form hills of more or less elevation, according to circumstances.

The coasts of Italy are lined with marble and rocks of different species. These rocks appear at a distance like perpendicular pillars of marble. The coasts of France, from Brest to Bourdeaux, consist almost entirely of rocks on a level with the sea, which occasion breakers. The coasts of England, of Spain, and of many other places, are bordered with rocks and hard stones, except particular spots which are employed as roads and harbours.

The depth of the water along the coasts is generally proportioned to their elevation; a high coast indicates a deep water; and, on low coasts, the water is commonly shallow. The inequalities at the bottom of the sea near the coasts likewise correspond with the inequalities in the surface of the ground along the shore. This subject is illustrated in the following manner by a celebrated voyager.

'I have made it my general observation, that, where 'the land is fenced with steep rocks and cliffs against 'the sea, there the sea is very deep, and seldom affords 'anchor-ground; and, on the other side, where the 'land falls away with a declivity into the sea, (although 'the land be extraordinary high within,) yet there are 'commonly good soundings, and consequently an-'choring; and, as the visible declivity of the land ap-'pears near, or at the edge of the water, whether pretty 'steep, or more sloping, so we commonly find our an-'chor-ground to be more or less deep or steep; therefore 'we come nearer the shore, or anchor farther off, as we 'see convenient; for there is no coast in the world, that 'I know, or have heard of, where the land is of a conti-'nual height, without some small valleys or declivities, 'which lie intermixed with the high land. They are 'the subsiding of valleys or low lands, that make dents 'in the shore and creeks, small bays and harbours, or 'little coves, &c. which afford good anchoring, the sur-'face of the earth being there lodged deep under water. 'Thus we find many good harbours on such coasts, 'where the land bounds the sea with steep cliffs, by 'reason of the declivities, or subsiding of the land be-'tween these cliffs: but, where the declension from the 'hills or cliffs is not within land, between hill and hill, 'but, as on the coast of Chili and Peru, the declivity is 'toward the main sea, or into it, the coast being per-'pendicular, or very steep from the neighbouring hills, 'as in those countries from the Andes, that run along 'the shore, there is a deep sea, and few or no harbours 'or creeks. All that coast is too steep for anchoring, 'and hath the fewest roads fit for ships of any coast I 'know. The coasts of Gallicia, Portugal, Norway, and 'Newfoundland, &c. are coasts like the Peruvian, and 'the high islands of the Archipelago; but yet not so 'scanty of good harbours; for, where there are short 'ridges of land, there are good bays at the extremities of 'those ridges, where they plunge into the sea; as on 'the coast of Caraccos, &c. The island of Juan Fer-'nandez, and the island of St. Helena, &c. are such 'high land with deep shore: and, in general, the plung-'ing of any land under water, seems to be in proportion 'to the rising of its continuous part above water, more 'or less steep; and it must be a bottom almost level, or 'very gently declining, that affords good anchoring, ships 'being soon driven from their moorings on a steep bank; 'therefore, we never strive to anchor where we see the land high, and bounding the sea with steep cliffs; 'and, for this reason, when we came in sight of States-'Island, near Terra del Fuego, before we entered into 'the South-Seas, we did not so much as think of 'anchoring after we saw what land it was, because of 'the steep cliffs which appeared against the sea; yet 'there might be little harbours or coves for shallops, 'or the like, to anchor in, which we did not see, or 'search for.

'As high steep cliffs bounding on the sea have this

'ill consequence, that they seldom afford anchoring; so 'they have this benefit, that we can see them far off, 'and sail close to them, without danger; for which 'reason we call them bold shores; whereas low land, on 'the contrary, is seen but a little way, and in many 'places we dare not come near it, for fear of running 'a-ground before we see it. Besides, there are, in many 'places, shoals thrown out by the course of great rivers, 'that from the low land fall into the sea.

'This which I have said, that there is usually good 'anchoring near low lands, may be illustrated by several 'instances. Thus, on the south side of the Bay of Cam- 'peachy, there is mostly low land, and there also is good 'anchoring all along shore; and, in some places to the 'eastward of the town of Campeachy, we shall have so 'many fathom as we are leagues off from land; that is, 'from 9 or 10 leagues distance, till you come within 4 'leagues; and from thence to land it grows but shal- 'lower. The Bay of Honduras also is low land, and 'continues mostly so, as we passed along from thence 'to the coasts of Portobel, and Carthagena, till we came 'as high as Santa Martha; afterwards the land is low 'again, till you come towards the coast of Caraccos, 'which is a high coast and bold shore. The land about 'Surinam, on the same coast, is low and good anchoring, 'and that over on the coast of Guinea is such also. 'And such, too, is the bay of Panama, where the pilot 'book orders the pilot always to sound, and not to 'come within such a deep, be it by night or day. In the 'same seas, from the high land of Gautimala in Mexico, 'to California, there is mostly low land and good an- 'choring. In the main of Asia, the coast of China, the 'bay of Siam and Bengal, and all the coast of Coro- 'mandel, and the coast about Malacca, and against it 'the island of Sumatra, on that side, are mostly low 'anchoring shores. But, on the west side of Sumatra, 'the shore is high and bold; so most of the islands lying 'to the eastward of Sumatra; as the islands Borneo, 'Celebes, Gilolo, and abundance of islands of less note, 'lying scattered up and down those seas, are low land, 'and have good anchoring about them; with many 'shoals scattered to and fro among them; but the 'islands lying against the East-Indian Ocean, especially 'the west sides of them, are high land and steep, parti- 'cularly the west parts, not only of Sumatra, but also 'Java, Timor, &c. Particulars are endless; but, in ge- 'neral, it is seldom but high shores and deep waters, 'and, on the other side, low land and shallow seas are 'found together. (Dampier's Voyages, vol. i. p. 422, 423, 424, 425.)

It is, therefore, fully established by the observations of navigators, that there are, in the bottom of the sea, considerable mountains, and other inequalities. We are also assured by the testimony of divers, that there are smaller inequalities occasioned by rocks, and that the cold is greatest in the hollows or valleys. In general, as formerly remarked, the depths of open seas augment in proportion to their distance from the coasts. It appears, from M. Buache's chart of that part of the ocean which lies between the coasts of Africa and America, and from the draughts he has given us of the sea from Cape Tagrin to Rio-grand, that the bottom of the ocean is as irregular as the surface of the land; that Abrolhos, where there are *vigies*, and where some of the rocks are on a level with the water, are only the tops of large and high mountains, of which Dolphin Island is one of the most elevated points; that the Cape de Verd Islands are likewise the tops of mountains; and that all round these abrolhos and islands, the depth of the sea is unfathomable.

With regard to the qualities of the different soils at the bottom of the sea, little can be said with precision, as all our knowledge is derived from sounding and from divers. We only know, that some places are covered with slime and mud of a considerable thickness, in which anchors can have no hold: it is probable that, in these places, the mud is deposited by rivers. Other parts are covered with sand of different kinds, similar to those upon land. In others are heaps of shells, madrepores, corals, and other productions of insects, just beginning to unite and to assume the form of stones: in others, we find fragments of stones, gravel, and frequently stones and marbles completely formed. In the Maldiva Islands, for example, they build their houses with a hard stone raised from some fathoms under water. At Marseilles very good marble is raised from the bottom of the sea, which, instead of wasting or destroying stones and marble, creates and preserves them: it is the sun, the earth, the air, and the rains, which alone corrupt and destroy these substances.

The bottom of the sea must be composed of the same materials as the surface of the earth, since the very same substances are found on both. At the bottom of some parts of the ocean are vast collections of shells, madrepores, and corals; and we find, upon land, numberless quarries, banks of chalk, and of other substances, mixed with the same shells, madrepores, and corals; so that, in every view, the dry parts of this globe resemble those covered with the waters, both in composition of materials, and in superficial inequalities.

To these inequalities at the bottom, we must ascribe the origin of currents; for, if the bottom were uniform and level, there could be no current but the general motion from east to west, and such as might occasionally be produced by the winds. But what incontestibly proves, that most currents are produced by the tides, and take their direction from inequalities at the bottom, is, that they uniformly follow the tides, and change their course at every ebb and flow. (See Pietro della Valle on the Currents in the Gulf of Cambaia, vol. vi. p. 363.)

This fact is confirmed by the testimony of all navigators, who unanimously affirm, that in those places where the tides are most impetuous, the currents are likewise most rapid.

Thus it is apparent, that the tides give rise to currents, and that they always follow the direction of the opposite hills or mountains between which they run. Currents produced by winds likewise observe the direction of the eminences concealed under the waters; for they seldom run in the direct path of the winds; neither do those produced by the tides invariably observe the course pointed out by their original cause.

To give a distinct idea of the origin of currents, let it be remarked, that they take place in all seas; that some are rapid, and others slow; that some are of great extent both in length and breadth, and others shorter and narrower; that the same cause by which they are produced, whether it be the wind or the tides, frequently bestows on each a difference both in celerity and direction; that a north wind, for example, which ought to produce a general motion towards the south, gives rise, on the contrary, to a number of separate currents, very different, both in their direction and extent, some running south, others south-east, and others south-west; some are rapid, others slow; some long and broad, and others short and narrow: in a word, their motions are so various and combined, that they lose all resemblance to their general cause. When a contrary wind blows, every motion is uniformly reversed; and the course of the different currents is precisely the same as would necessarily take place between two opposite and neighbouring hills upon the surface of the land, were it covered with water. Of this, the Maldiva and Indian islands, where the winds blow and the currents run regularly for six months in opposite directions, afford most striking examples. The same thing has been remarked of currents between shoals and sand-banks. In general, all currents, from whatever cause they proceed, have the same dimensions, and the same direction through their whole course; but they differ greatly from each other in every respect. This uniformity and variety can proceed from no other cause but the inequalities of the hills, mountains, and valleys, at the bottom of the ocean; for, it is an established fact, that the current between two islands follows the direction of the coasts; and the same phænomenon is exhibited between shoals and sand-banks. The hills and mountains in the sea, therefore, may be considered as the banks which contain and direct the currents: hence a current in a river, the breadth of which is determined by that of the valley through which it runs; its rapidity is proportioned to the force by which it is produced, combined with the breadth of the interval through which it passes; and its direction is marked out by the position of the hills and other inequalities between which it shapes its course.

An opportunity is now afforded us of explaining that singular correspondence between the angles of hills and mountains, which is observable in every country of the world. We have already remarked this uniform correspondence of angles in the banks of rivers. The cause of this effect depends on the laws of hydrostatics, and might be easily explained. But it is sufficient for our present purpose, that the fact is general, and universally known; and every man may satisfy himself with his own eyes, that, when the bank of a river projects into the land, to the left, for instance, the opposite bank, on the contrary, makes a projection from the land on the right.

The currents of the ocean, therefore, which ought to be regarded as large rivers, and as subject to the same laws as those on land, must, like them, have formed, through the whole extent of their course, many sinuosities or windings with corresponding angles or projections: and, as the banks of currents are hills and mountains, either above or below the surface of the water, they must have produced on these eminences the same effects as our rivers do upon their banks. Thus, we have no longer any reason to be astonished, that our hills and mountains, which were formerly covered with the sea, and formed by the sediments of its waters, should have assumed, by the motion of its currents, this regular figure, arising from the correspondence of their opposite angles. They were originally banks of currents, or of sea-rivers, and must necessarily have assumed a figure and direction similar to those of land-rivers.

This alone, independent of the other proofs which we have adduced, is sufficient to show, that all our present continents and islands were formerly covered with the waters of the ocean, and throws much light on the theory which I have been endeavouring to establish. It was not enough to have proved that the internal strata of the earth were formed by sediments of the waters; that the mountains were elevated by successive accumulations of these sediments; or, that many strata were impregnated with shells and other productions of the sea. It was still necessary to investigate and assign the real cause of the correspondence in the angles of mountains, which hitherto had never been attempted, but which, when united with the other proofs, forms a connected chain of evidence in support of my theory, as complete as the nature of physical reasoning will admit.

The most conspicuous currents of the ocean are those in the Atlantic near the coast of Guinea. They extend from Cape Verd to the bay of Fernandpo. They run from west to east, which is contrary to the general motion of the sea; and they are so rapid, that vessels sail in two days from Moura to Rio de Benin, about 150 leagues, but require six or seven weeks to return. It would be impossible to clear these latitudes, were it not by means of the tempestuous winds which suddenly

arise in them: but there are sometimes whole seasons in which the mariner is obliged to remain stationary, on account of perpetual calms, the sea having here no motion but what it derives from the currents; and these always run in upon the coasts, from which they extend not above 20 leagues. Near the island of Sumatra, there are rapid currents which run from south to north, and which have probably given rise to the bay between Malacca and India. We find similar currents between Java and the lands of Magellan, and between the Cape of Good Hope and Madagascar, especially on the African coast from Natal to the Cape. In the Pacific Ocean, upon the coasts of Peru, and the rest of America, the waters move from south to north, which is probably owing to the constant blowing of the south wind. The same motion from south to north has been remarked on the coasts of Brazil, from Cape St. Augustine to the Antilles, and from the mouth of the Manilla straits to the Philippines and Japan. (See Varen. Geogr. p. 140.)

There are violent currents in the neighbourhood of the Maldiva Islands; and between these islands, as already observed, the currents run alternately in opposite directions six months in the year, and are probably occasioned by the trade-winds.

We here enumerate such currents only as are remarkable both for their extent and their rapidity; because the number of lesser currents is almost infinite. The tides, the winds, and every cause that agitates the waters, produce currents, which are more or less perceptible in different places. We have already remarked, that the bottom of the sea is, like the land, intersected with mountains and valleys, shoals and sand-banks. In all the mountainous places, the currents must necessarily be violent; and, where the bottom is smooth and level, they are almost imperceptible; for the rapidity of a current must augment in proportion to the obstacles with which the waters have to encounter. The current between two chains of mountains will be more or less violent in proportion to their distance. The same thing must happen between two banks of sand, or two adjacent islands. It is, accordingly, remarkable, that in the Indian Ocean, which is intersected with an innumerable quantity of islands and sand-banks, there are every where currents, which, by their rapidity, render navigation extremely dangerous.

Currents are not only occasioned by inequalities at the bottom, but a similar effect is produced by the coasts, from which the waters are repelled to greater or less distances. This regorging of the waters may be rendered perpetual and violent by particular circumstances: an oblique position, for example, of a coast, its contiguity to a bay or a great river, a promontory, or any particular obstacle to the general movement of the waters, will always give rise to a current: now, as nothing is more irregular than the bottom and the coasts of the sea, the number of currents which every where appear ought not to create surprise.

All currents have a determinate breadth, proportioned to the interval between the two eminences which limit them. They run in the same manner as land-rivers; they form a channel, and cut their banks in a regular manner, with corresponding angles: in fine, the currents of the ocean have scooped out our valleys, shaped our mountains, and bestowed upon the land, while it remained under the surface of the waters, the form in which it now appears.

If any doubt should remain concerning the correspondence in the angles of mountains, I appeal to the testimony of every man's observation. Every traveller may remark this correspondence in opposite hills. When a hill makes a projection to the right, the opposite one uniformly recedes to the left. Besides, in opposite hills separated by valleys, there is rarely any difference in their height. The more I observe the contours and elevations of hills, I am the more convinced of the correspondence of their angles, and of their resemblance to the channels and banks of rivers. It was the repeated observation of this surprising regularity and resemblance that first suggested the idea of the theory of the earth which I am now supporting. When to this are added the parallelism of the strata, and the shells so universally incorporated with different materials, no subject of this nature can admit of a greater degree of probability.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XIV.

Of Regular Winds.

In our climates, nothing can appear to be more capricious and irregular than the force and direction of the winds. But there are some countries where this irregularity is not so great, and others where the wind blows constantly in the same direction, and with nearly the same degree of force.

Though the motions of the air depend on many causes, yet there are some more constant and powerful than others. But it is difficult to estimate their precise effects, because these are often modified by secondary causes.

The heat of the sun is the most powerful cause of winds. It produces a considerable and successive rarefaction in the different parts of the atmosphere, and gives rise to an east-wind, which blows constantly between the Tropics, where the rarefaction is greatest.

The force of the sun's attraction upon the atmosphere, and even that of the moon, are inconsiderable, when compared with the cause just mentioned. This force, it is true, produces a motion in the air similar to that of the tides in the sea. But, though the air is elastic, and 800 times lighter than water, the motion produced by attraction cannot exceed what is excited in the waters of the ocean by the same cause; for the action of gravity being proportioned to the quantity of matter, it must elevate a sea of water, of air, or of quicksilver, nearly to the same height. Hence the influence of the planets upon the air must be inconsiderable; and, though it must occasion a slight motion from east to west, this motion becomes altogether insensible when compared with that produced by the heat of the sun: but as the rarefaction is always greatest when the sun is in the zenith, the current of air must follow the course of the sun, and produce a constant wind from east to west. (See Reflections sur la Cause Generale des Vents, par M. D'Alembert.) At sea, this wind blows perpetually in the Torid Zone, and, at land, in most places between the Tropics. It is this wind which we perceive when the sun rises; and, in general, east winds are more frequent, and more violent than west winds. The general wind, from east to west, extends even beyond the Tropics. It blows so constantly in the Pacific Ocean, that the ships coming from Acapulco to the Philippines, perform their voyage, which is more than 2700 leagues, without the least danger, and almost without the necessity of being directed. In the Atlantic, between Africa and Brazil, this wind is equally constant. It is likewise felt between the Philippines and Africa; but there it is less constant, on account of the obstacles it meets with from the numerous islands in that sea; for it blows, during the months of January, February, March, and April, between the Mozambique coast and India; but it gives place to other winds during the rest of the year. And, though it is less perceptible on the coasts than on the open sea, and still less in the interior parts of continents than on the coasts, yet, in some places, it blows almost perpetually, as on the east coasts of Brazil, of Loango in Africa, &c.

This wind is constant under the Line; and, therefore, in going from Europe to America, mariners direct their course southward, along the coasts of Spain and Africa, till they come within 20 degrees of the Equator, where they fall in with the east, or trade-wind, which carries them directly to the coast of America. By means of the same wind, the voyage from Acapulco to the Philippines is performed in two months; but the return from the Philippines to Acapulco is much more difficult, and requires a longer time. About 28 or 30 degrees on this side of the Line, the west wind is equally constant; and, for this reason, the vessels returning from the West Indies to Europe, observe not the same route as in going out. Those from New Spain run north along the coast till they arrive at the Havannah, in the island of Cuba; and from thence they proceed northward till they fall in with the west wind, which carries them to the Azores, and then to Spain. In the same manner, vessels returning by the South Sea from the Philippines or China, to Peru or Mexico, sail north as far as Japan; and, under that latitude, they proceed till they arrive at a certain distance from California; and from thence, following the coast of New Spain, they reach Acapulco. These east winds blow not always from the same point; but, in general, they blow from the south-east, from April to September, and from the north-east from November to April.

The east wind, by its constant action, augments the general motion of the sea from east to west. It also produces perpetual currents, some of them running from

east to west, and others from east to south-east, or north-west, according to the direction of the eminences, or chains of mountains, below the surface. The valleys or intervals between them serve as channels to these sea-rivers. The variable winds, which blow sometimes from the east, and sometimes from the south, likewise produce currents, which change their direction with that of the wind.

The winds that blow constantly for some months are commonly succeeded by contrary winds, which oblige the mariner to wait for that which is favourable to his destination. When these winds change, they often produce, for several days, and sometimes for a month, or even two months, a perfect calm, or dreadful tempests.

These general winds, occasioned by the rarefaction of the atmosphere, are variously combined and modified by different causes, and in different climates. In that part of the Atlantic which lies under the Temperate Zone, the north wind blows almost constantly during the months of October, November, December, and January. These months, therefore, are most favourable for ships going to the Indies, which are carried over the Line by this wind. And it is a well known fact, that vessels which depart from Europe in March, frequently arrive not sooner at Brazil than those which set out in the following October. The north wind reigns almost perpetually during the winter, off Nova Zembla, and other northern coasts. At Cape de Verd, the south wind blows during the month of July, which is the rainy season, or winter, in that climate. At the Cape of Good Hope, the north-west wind blows during the month of September: the same wind blows at Patna in the East Indies, during the months of November, December, and January, and occasion great rains; but the east wind prevails during the other nine months. In the Indian Ocean, between Africa and India, and as far as the Molucca Islands, the trade-wind from east to west reigns from January to the beginning of June; the west winds begin in August or September; and in the interval between June and July, there are dreadful tempests, generally from the north winds; but these winds are more variable on the coasts than in the open seas.

In the kingdom of Guzarat, and upon the neighbouring coasts, the north winds blow from March to September; and, during the other months, the south winds almost always prevail. The Dutch, in returning from Java, set out in January or February, by the assistance of the east wind, which is felt as far as the 18th degree of south latitude; and then they meet with south winds, which carry them to St. Helena. (See Varen. Geogr. cap. 20.)

Some regular winds are produced by the melting of the snows. This was remarked by the ancient Greeks. During summer, a north-east wind, and a south-east one during winter, was observed to take place in Thracia, in Macedonia, in the Egean Sea, and even in Egypt and Africa; and winds of the same kind have been remarked in Congo, at Guzurat, and at the extremity of Africa, which are all occasioned by the melting of the snows. Regular winds, which last but a few hours, are also produced by the motion of the tides; and, in many places, as on the coasts of New Spain, of Congo, of Cuba, &c. a wind blows from the land during the night, and from the sea during the day.

The north winds are equally regular within the polar circles; but they become more and more imperceptible as we approach the Equator. This remark is applicable to both poles.

In the Atlantic and Ethiopic Océan, within the tropics, an east wind blows during the whole year, without any considerable variation, except in some small spots, where it changes according to the situation of coasts, and other circumstances: 1st. Near the coast of Africa, and about the 28th degree of North latitude, vessels are certain of finding a fresh gale from the north-east, or north-north-east, which accompanies them to the 10th degree of the same latitude, about 100 leagues from the coast of Guinea; and, at the 4th degree of north latitude, they meet with calms and tornados. 2d. In going by the Caribbee Islands, this wind turns more and more easterly, in proportion as vessels approach the American coast. 3d. The limits of these variable winds, in the Atlantic, are more extensive upon the coasts of America than upon those of Africa. Along the coast of Guinea, from Sierra Leona to the island of St. Thomas, an extent of about 500 leagues, there is a perpetual south, or south-west wind. The narrowest part of the Atlantic is from the coast of Guinea to Brazil, where it is not above 500 leagues over. Vessels, however, that depart from Guinea, are obliged to shape their course southward, especially when they set out in the months of July or August, in order to fall in with the south-east winds, which blow constantly during this season. (See Phil. Trans. abridg. vol. ii. p. 129.)

In the Mediterranean, the east wind blows from the land in the evening, and the west wind from the sea in the morning. The south wind, which is accompanied with rain, and blows commonly during the latter end of autumn, at Paris, in Burgundy, and Champagne, yields to a mild north-east wind, which produces that fine weather vulgarly called Saint Martin's Summer. (See Traité des Eaux de M. Mariotte.)

Doctor Lister alledges, that the east wind, which reigns during the whole year between the tropics, is occasioned by the transpiration of the plant called the *sea lentil*, which abounds in these climates; and that the difference of land-winds is owing to the different situation of trees and forests. This ridiculous whim he assigns as the cause of the winds; and, in his opinion, the wind is strongest at mid-day because the transpiration

from plants is then greatest; and the wind, continues he, blows from east to west, because all plants are, in some measure, sunflowers, and transpire most from the side opposed to the sun. (See Phil. Trans. No. 156.)

Other authors have assigned the diurnal motion of the earth as the cause of this east wind. This notion is specious: but every man, who has the least knowledge of physics, must allow, that no fluid which surrounds the earth can be affected by its rotation; that the air must move along with the earth itself; and that the rotatory motion is equally imperceptible in the atmosphere as on the surface of the earth.

The principal cause of the winds, as already remarked, is the heat of the sun; (see Halley's Treatise on this subject in the Phil. Trans.) for, whatever rarifies or condenses the air, must produce a wind, or current, in a direction opposite to those places where the rarefaction or condensation is greatest.

The pressure of clouds, exhalations from the earth, the explosion of meteors, rains, &c. likewise produce considerable agitations in the atmosphere. Each of these causes, when variously combined, produce different effects. As it is in vain to attempt a complete theory of the winds, I confine myself to their history.

If we had a series of observations upon the direction, the force, and the variations of the winds in the different climates of the earth, and if these observations were sufficiently numerous and exact, we might be enabled to form more complete ideas with regard to the causes of the different changes in the atmosphere.

The winds are more regular at sea than upon land; because their motion is not interrupted. But, upon land, the direction is frequently changed by the interposition of mountains, forests, cities, and other obstacles. Winds are often reflected from mountains with a force nearly equal to that of their original current: these winds are exceedingly irregular, because their direction depends on the contour, the height, and the situation of the mountains from which they rebound. The sea-winds also blow with more force and uniformity, and last longer: the land-winds, however violent, have intermissions, and moments of repose: but, at sea, the current of the air, having no obstacles to contend with, is uniform and perpetual.

At sea, the east winds, and those which come from the Poles, are generally stronger than the west winds, and those that proceed from the equator. But, at land, the south and west winds are more or less violent, according to the different situation of particular countries. During spring and autumn, the winds, both at sea and land, are more violent than in summer or winter. For this fact, several reasons may be assigned: 1. In spring and autumn the tides are highest; and, consequently, the winds they excite are most violent during these seasons: 2. The motion produced in the atmosphere by the action of the sun and moon, or the tides of the air, must likewise be greatest about the equinoxes: 3. The melting of the snows in spring, and the condensation of the vapours exhaled in summer by the sun, and which fall down in the autumn in the form of rain, produce, or at least, augment the force of the winds: 4. The transition from heat to cold, or from cold to heat, must create considerable augmentation and diminution in the volume of the air, which alone is sufficient to raise great winds.

Contrary currents in the atmosphere have often been remarked. We see some clouds moving in one direction, and others, either above or below them, proceeding in a direction perfectly opposite. This contrariety of motion never continues long; because its general cause is the resistance of some large cloud, which reflects the wind in a direction opposite to its natural course, but is soon dissipated.

The winds are more violent in proportion to the elevation of the ground, till it arrive at the ordinary station of the clouds, which is about one-fourth or one-third of a league perpendicular height; and beyond this, the sky is generally serene, especially in summer, and the wind gradually diminishes: it is even said to be altogether imperceptible on the tops of the highest mountains. However, as the summits of these mountains are covered with ice and snow, it is natural to think that this region of the air is agitated during the fall of the snows, and that the winds are imperceptible in the summer season only. The light vapours which are raised in summer fall in the form of dews; but, in winter, they are condensed, and fall on the tops of the mountains in the form of snow or ice, which may raise considerable winds at that altitude.

The celerity of a current of air is augmented when its passage is contracted. The same wind, which is but slightly felt in a large open plain, becomes violent in its progress through a narrow pass in a mountain, or between two high houses; and it is most violent at the tops of the buildings or of the mountain, because the air, being compressed by these obstacles, is augmented both in volume and in density; and, as its celerity remains the same, its force or momentum must be increased. It is for this reason that the wind appears to be more violent near a church or a tower than at a distance from them. I have often remarked, that the wind reflected from a building standing by itself, is stronger than the direct wind by which it was produced. This effect can be owing to no other cause than the compression of the air against the building from which it rebounds.

As the density of the air is greatest at the surface of the earth, it is natural to conclude, that the wind must there also be most violent; and this conclusion is, I apprehend, just, when the sky is serene: but, when it is charged with clouds, the action of the wind will be most

violent at the height of the clouds, which are denser than air, as they fall in the form of rain or of hail. In computing the force of wind, therefore, we ought to estimate not only its velocity, but likewise the density of the air; for two winds, of equal velocities, may differ greatly in their force, if the densities of the air be unequal. From this remark, we may learn the imperfection of those machines which have been employed for measuring the velocity of the winds.

Particular winds, whether they be direct or reflected, are more violent than those which are general. The interrupted action of land-winds depends on the compression of the air, which renders every blast more violent than if the current were uniform. A uniformly continued stream of air produces not such havock as the fury of those winds which blow, as it were, by paroxysms. But of this we shall treat more fully in the next article.

The winds, in their various directions, may be considered under general points of view, from which, perhaps, some useful deductions may be drawn. For example, the winds may be divided into Zones. The east wind, which extends 25 or 30 degrees on each side of the Equator, exerts its force round the globe within the Torrid Zone. The north wind blows with equal constancy in both the Frigid Zones. Thus, the east wind occupies the Torrid Zone, and the north wind the Frigid Zones. With regard to the Temperate Zones, the winds peculiar to them may be considered only as currents of air, produced by the combination of the two principal winds, which give rise to all those that come from the eastern points; and the west winds, which are common in the Temperate Zones, both in the Pacific and Atlantic Oceans, may be considered as reflections from the continents of Asia and America, but deriving their origin principally from the east and north winds.

Though we have said, that, generally speaking, the east wind blows round the globe 25 or 30 degrees on each side the Equator; yet it must be acknowledged, that, in some places, it extends not so far, and that its direction is not throughout from east to west; for, on this side of the Equator, it is east-north-east, and, beyond the Equator, it is east-south-east; and, the more we recede from the Equator, its direction is the more oblique. The Equator is the line under which the direction of the wind from east to west is most exact. In the Indian Ocean, for example, the general wind from east to west extends not above 15 degrees beyond the Equator. In going from Goa to the Cape of Good Hope, this wind is not felt beyond the 12th degree of south latitude, nor is it perceptible on this side of the Equator. But, after arriving at the 12th degree of south latitude, this wind continues to the 28th degree. In the sea which separates Africa from America, there is an interval from the 4th degree of north latitude to the 10th or 11th of south latitude, where this general wind is not perceived. But, beyond the 10th or 11th degree, it extends to the 30th.

There are likewise many deviations in the trade-winds, which have an alternate motion. Some continue for a longer or shorter time; others have a greater or lesser extent; others are more or less regular, and more or less violent. The following, according to Varenius, are the principal phænomena of these winds: 'In the ocean 'between Africa and India, and as far as the Molucca 'Islands, the east wind commences in January, and con-'tinues till the beginning of June. In the month of 'August, the west wind begins, and continues for three 'or four months. In the interval between these trade-'winds, which is from the end of June to the beginning 'of August, the sea is infested with violent tempests 'from the north.

'These winds are subject to the greatest variations 'near the coasts: vessels cannot take their departure 'from the coast of Malabar, and other ports on the west 'coast of the peninsula of India, to Africa, Arabia, or 'Persia, but from the month of January to April or May; 'for, at the end of May, and during the months of June, 'July, and August, the tempests from the north and 'north-east are so violent, that no ships can keep the 'seas. But, on the other side of this peninsula, in the 'sea which washes the coast of Coromandel, there are 'no tempests of this kind.

'Vessels depart from Java, Ceylon, and several other 'places, for the Moluccas, in September, because the 'west wind begins then to blow in these regions. How-'ever, when 15 degrees south of the Equator, this wind 'ceases, and they fall in with the trade-wind, which, in 'this place, blows from the south-east. In the same 'manner, vessels depart from Cochin for Malacca in 'March; because, at this time, the west wind begins to 'blow. Thus the west winds arise at different times, in 'different parts of the Indian Ocean. The times of de-'parture are different from Java to the Moluccas, from 'Cochin to Malacca, from Malacca to China, and from 'China to Japan.

'At Banda, the west winds terminate at the end of 'March; calm and variable winds occupy the month of 'April; and the east winds begin with great violence in 'May. At Ceylon, the west winds commence about the 'middle of March, and continue to the beginning of 'October, when the east, or rather east-north-east 'winds, return. At Madagascar, they have north or 'north-west winds from the middle of April to the end 'of May; but east and south winds in February and 'March. From Madagascar to the Cape of Good Hope, 'the northerly winds prevail during the months of March 'and April. In the Gulf of Bengal, after the 20th of

'April, the south winds blow with violence; and, before 'this period, the south-west and north-west winds pre- 'vail. The westerly winds are also violent in the Chinese 'Sea during the months of June and July. This is, 'therefore, the most proper season for sailing from 'China to Japan: but, in returning from Japan to 'China, February and March are preferable, because the 'easterly winds then prevail.

'There are some winds which may be considered as 'peculiar to certain coasts: for example, a south wind 'blows almost perpetually on the coasts of Chili and 'Peru. It begins about the 46th degree of south lati- 'tude, and extends beyond Panama, which makes the 'voyage from Lima to Panama more easy and expedi- 'tious than the return. The westerly winds blow al- 'most continually on the coasts of Magellan's land, in 'the neighbourhood of the Straits of La Maire. Upon 'the Malabar coast, they have almost constantly north 'and north-west winds. The north wind is very fre- 'quent on the coast of Guinea. The westerly winds 'reign upon the coasts of Japan during the months of 'November and December.'

The periodic, or alternate winds, mentioned above, are peculiar to the sea. But, upon land, there are also periodic winds, which return at certain seasons or particular days, or even at stated hours. On the coast of Malabar, for example, an easterly land-wind blows from September to April: it generally commences at midnight, and ends at noon; and it is not perceptible at 12 or 15 leagues from the coast. From noon to midnight, there is a gentle westerly breeze from the sea. Upon the coasts of New Spain in America, and upon those of Congo in Africa, land-winds blow during the night, and sea-winds during the day. Winds blow from all the coasts of Jamaica during the night, which prevents the landing, or sailing of ships, with safety, before the rising of the sun.

In winter, the port of Cochin is inaccessible; neither can any vessel get out; because the winds are so impetuous, that no vessels can keep the sea; and, besides, the west wind, which blows with great fury, drives such a quantity of sand into the mouth of the river, as renders it impossible for ships of any burthen to enter it for six months of the year. But the east wind, which blows during the other six months, drives back the sand into the sea, and opens the mouth of the river. At the straits of Babelmandel, there is a south-east wind, which is regularly succeeded by the north-east. At St. Domingo, there are two different winds that rise regularly every day; the one, which is from the sea, comes from the east, and begins at 10 o'clock before noon; the other, which is a land-wind, from the west, rises at 6 or 7 in the evening, and continues the whole night. Other facts of this kind, collected from voyagers of knowledge and credit, might furnish a complete history of the winds, which would be a work extremely useful both in navigation and physics.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XV.

Of Irregular Winds, Hurricanes, Water-Spouts, and other Phænomena, occasioned by the agitations of the Sea, and of the Air.

THE winds are more irregular on the land than on the sea, and in high than in low countries. The mountains not only change the direction of the winds, but even produce some, which are either constant or variable, according to their causes. The melting of snows on the tops of mountains generally give rise to constant winds, which last a considerable time. The vapours that strike against the mountains, and accumulate upon them, produce variable winds, which are very common in all climates; and there is as great a variety in the motions of the air, as there are inequalities on the surface of the earth. We can, therefore, give examples only, and a genuine history of facts: and, as a connected series of observations upon the variations of the winds, and even of the seasons, in different countries, is still wanting, we shall not attempt to explain all the causes of these variations, but shall confine ourselves to those which are most probable.

In straits, at the extremities of promontories, peninsulas, and capes, and in all narrow bays, tempestuous winds are frequent. But, independent of these, some seas are much more infested with storms than others. The Indian Ocean, the seas of Japan and of Magellan, along the African coast beyond the Canaries, and the opposite coast near Natal, and the Red and Vermilion Seas, are all subject to tempests. The Atlantic is likewise

more tempestuous than the great ocean called the Pacific. This last ocean, however, is no where perfectly tranquil, except between the tropics; for the nearer we approach the poles, it is the more subject to variable winds, the sudden changes of which produce tempests.

All continents are subject to the effects of variable winds, which are sometimes very singular. In the kingdom of Cassimir, which is surrounded with the mountains of Caucasus, a most sudden reverse of seasons is felt on Mount Pirepenjale. In less than an hour's journey, we pass from summer to winter. A north and a south wind, according to Bernier, blow perceptibly within 200 paces of each other. The position of this mountain must be singular; and, therefore, it merits a particular examination. In the peninsula of India, which is traversed from north to south by the mountains of Gate, the extreme heats of summer are felt on one side of these mountains, and all the rigours of winter on the other. The same phænomenon takes place on the two opposite coasts of Cape Rosalgate in Arabia: on the north coast the sea is calm and tranquil; while the south coast is infested with continual storms. Ceylon exhibits another example of this phænomenon. Winter and high winds reign in the north part of the island, while, on the south side of it, fine weather and summer heats prevail. Of opposite seasons in the neighbourhood of each other, and at the same time, there are several examples, not only on the continent, but on the islands, as at Cerem, a long island near Amboyna, in the north part of which it is winter, and summer in the south part; and the interval between these two seasons is not above three or four leagues.

In Egypt a south wind prevails during summer, which is so hot as to stop respiration; and it raises such immense quantities of sand, that the sky seems to be covered with thick clouds. This sand is so fine, and is blown with such violence, that it penetrates the closest chests. When this wind continues for several days, it gives rise to epidemic diseases, which frequently cut off vast numbers of men. It seldom rains in Egypt; every year, however, there are some days of rain in the months of December, January, and February. But thick fogs are more frequent than rain, especially in the neighbourhood of Cairo. These fogs commence in November, and continue during the winter; and, through the whole year, even when the sky is serene, the dews fall so copiously, that they have all the effects of rain.

In Persia, the winter commences in November, and lasts till March. The cold is strong enough to produce ice; and snows fall in the mountains, and sometimes in the plains. From March to May, there are violent winds, which recal the warmth of summer. From May to September the sky is serene, and the heats are moderated during the night by fresh breezes which continue till morning; and, in autumn, there are violent winds, like those which blow in the spring. However, though these winds are very strong, they seldom produce tempests or hurricanes. But, in summer a very noxious wind blows along the Persic Gulf, which is called *Samiel* by the natives; it is still hotter and more terrible than that of Egypt; and as it acts like an explosion of inflamed vapour, it suffocates every person who unhappily falls within its vortex. A similar wind rises in summer along the Red Sea, which suffocates animals, and transports such quantities of sand, that many people imagine this sea will, in the course of time, be completely filled up. Arabia gives birth to frequent clouds of sand which darken the air, and excite dangerous whirlwinds. At Vera Cruz, when the hot winds blow from the north, the houses of that town are almost buried with sand. Hot winds are also felt in summer at Negapatam in India, and likewise at Petapouli and Masulapatam. These scorching winds which kill men, are fortunately of no long duration; but they are extremely violent, and their heat and deleterious quality are proportioned to their velocity, which is contrary to the nature of other winds; for the more their rapidity, they are the more wholesome and refreshing. This difference proceeds from the degree of heat in the air. When the heat of the air is less than that of the body, the motion of the air is agreeable. But, when the heat of the air is greater than that of the bodies of animals, its motion scorches and suffocates. At Goa, the winter, or rather the rainy and tempestuous season, is in the months of May, June, and July, and it cools and refreshes the air, which would otherwise be perfectly insupportable in that region.

The Cape of Good Hope is famous for its tempests, and a peculiar cloud which produces them. This cloud at first appears like a small round spot in the heavens, which mariners distinguish by the name of the *Ox's Eye*. The seeming smallness of this cloud is probably owing to its great height. Of all voyagers who mention this cloud, Kolbe appears to have examined it with the greatest attention. 'This cloud,' says he, 'which appears 'on the mountains of the *Table*, or of the *Devil*, or of 'the *Wind*, is composed, if I am not deceived, of an 'infinite number of particles pushed, in the first place, 'against the mountains to the east of the Cape, by the 'east wind which blows in the Torrid Zone during 'almost the whole year. These particles or vapours are 'stopped by the high mountains, and are collected on 'their east side. They then become visible in the form 'of small fragments of clouds, which, by the constant 'action of the east wind, are elevated to the tops of the 'mountains. Here they remain not long at rest; but, 'being forced to advance, they sink down between the 'mountains which are still before them, where they are 'locked up and squeezed on all sides as in a canal. The 'wind presses these vapours from above, and the oppo-'site sides of the two mountains confine them on the

'right and left, till, in their progress, they advance to 'the foot of some mountains where the country is more 'flat and open; they then expand, and become again invisible. But they are soon pushed against another 'ridge of mountains by fresh clouds coming up behind 'them; and in this manner they proceed till they arrive 'with vast impetuosity at the top of the highest moun-'tains of the Cape, which are those of the *Wind* or of 'the *Table*, where they are met by a wind blowing in 'the opposite direction. Here a dreadful conflict en-'sues. The vapours are pressed both before and behind, 'which produces terrible whirlwinds, either on the 'mountains of the *Table*, or in the valleys. When the 'north-west wind yields, that of the south-east increases, 'and continues to blow with more or less violence for 'six months. When the *Ox's Eye* is thick, the force of 'the south-east wind augments, because the vapours 'amassed behind the mountains continually press for-'ward; for the same reason, this wind diminishes when 'the *Ox's Eye* is thin; and it entirely ceases when the '*Ox's Eye* vanishes, because no vapours arrive from the 'east.

'The circumstances attending this phænomenon lead 'to the following hypothesis; 1. Behind the mountain 'of the *Table*, a train of thin white vapour is observed, 'which commences on the eastern declivity of this 'mountain, ends in a sharp point at the sea, and occu-'pies, in its extent, the whole mountains of *Stone*. 'I have often contemplated this train, and imagined it 'to originate from the rapid motion of the vapour above 'described, from the mountains of *Stone* to those of the '*Table*.

'2. The passage of these vapours must be extremely 'embarrassed by the contrary shocks received, not only 'from the mountains, but from the south and east winds 'which prevail in the neighbourhood of the Cape. 'I have already mentioned the two mountains situated 'on the points of *False Bay*, the one called the *Hanging* '*Lip*, the other the *Norvege*. When the particles or 'vapours, which I have conjectured, are pushed against 'these mountains by the east winds, they are repelled 'by the south winds and driven against the neighbouring 'mountains, where they are detained for some time, and 'appear like clouds, as they often do upon the moun-'tains of *False Bay*, and even beyond them. These 'clouds are frequently very thick above the land 'in the possession of the Dutch, upon the moun-'tains of *Stellenbosck*, of *Drakenstein*, and of *Stone*, but 'especially upon the mountains of the *Table* and of the '*Devil*.

'Lastly, The constant appearance of small black clouds 'upon the *Lion's Head* two or three days before the 'south-east winds blow, confirms me in my conjecture; 'for these clouds, in my opinion, are composed of the 'particles of vapour mentioned above. If the north-'west wind prevails when these particles arrive, their 'course is stopped; but they are never driven to any 'great distance till the south-east wind commences.' (Tom. i. p. 224.)

The navigators who first approached the Cape of Good Hope, were ignorant of the effects of these clouds, which seemed to arise slowly and without any agitation in the air, but which, in a moment, excite the most furious tempests, and precipitate the largest vessels to the bottom of the ocean. In the country of Natal, a cloud, similar to the Ox's Eye at the Cape, produces the same direful effects. These species of tempests are frequent in the Atlantic, especially in the neighbourhood of the Equator. Near the coast of Guinea, three or four of these storms sometimes happen in a day, which are likewise occasioned and announced by small black clouds, while the rest of the sky is generally serene, and the sea perfectly calm. It is principally in April, May, and June, that these furious storms arise along the coast of Guinea, because no regular winds blow there at that season. On the coast of Loango the stormy season is in the months of January, February, March, and April. At Cape Gardafui, on the other side of Africa, they have storms of this kind in May, and the clouds which produce them are generally in the north, like those of the Cape of Good Hope.

All these storms originate from winds which issue from a cloud; and their direction is from north to south, or from north-east to south-west, &c. But there are tempests of another kind, called Whirlwinds, which are still more violent, and in which the wind seems to blow from every quarter at once. Their motion is circular, and nothing can resist their fury. They are generally preceded by a dead calm; but, in an instant, the waves are elevated to the clouds by the fury of the winds. Some parts of the sea cannot be approached; because they are perpetually infested either with calms or whirlwinds. These places have been called *calms* and *tornados* by the Spaniards. The most considerable of them are near Guinea, about the 2d or 3d degree of north latitude. They extend about 300 or 350 leagues in length, and nearly as much in breadth, which includes a space of 100,000 square leagues.

When contrary winds arrive at the same time in the same place, they produce whirlwinds, by the opposite motion of the air, in the same manner as whirlpools are produced in the sea by contrary currents. But when these opposite winds are counterbalanced by their distant action upon each other, they then revolve in a great circle, and produce a perfect calm, which it is impossible for vessels to navigate. These places are all marked in the globes of Mr. Senex. I am inclined to think, that the contrariety of winds alone, if not assisted by the direction of the coasts, and the particular structure of the bottom of the sea in these places, could not produce

this effect. I imagine that the currents, which are in effect occasioned by the winds, but assume their direction from the figure of the coasts and the inequalities at the bottom, terminate in these places; and that their opposite motions, in a plain surrounded with a chain of mountains, give rise to the tornadoes in question.

Whirlpools seem to be nothing else but circular motions of the waters occasioned by the action of two or more opposite currents. The Euripus, so famed by the death of Aristotle, alternately absorbs and rejects the water seven times every 24 hours. This whirlpool is near the coast of Greece. Charybdis, which lies near the Straits of Sicily, rejects and absorbs the water thrice in 24 hours. We are uncertain as to the number of alternate motions in other whirlpools. Dr. Placentia informs us, that the motions of the Euripus are irregular for 18 or 19 days every month, and regular during the other 11; and that it seldom swells above one, or at most two feet. He farther informs us, that authors are not agreed as to the tides in the Euripus; that some say it is twice, others seven times, some 11, others 12 or 14 times in 24 hours; but that Loirius, who examined it attentively, found that the tides rose regularly every six hours, and that their motion was sufficient to turn a mill-wheel.

The largest known whirlpool is in the sea of Norway, the circumference of which exceeds 20 leagues. It absorbs, for six hours, water, whales, ships, and any thing that approaches it, and the next six hours are employed in throwing them up again.

To account for these whirlpools, it is unnecessary to have recourse to an abyss, or to pits in the bottom of the sea, which are perpetually swallowing the waters. It is well known, that, when water runs in two directions, the combination of these motions produces a whirling, and exhibits the appearance of a void space in the middle. In the same manner, whirlpools in the sea are occasioned by two or more contrary currents; and, as the tides are the principal cause of currents, and, of course, they run for six hours in contrary directions, it is not surprising, that the whirlpools which are produced by them should alternately reject and absorb every thing within their reach during the same portion of time.

Whirlpools, then, are occasioned by contrary currents, and whirlwinds by the conflict of contrary winds. These whirlwinds are common in the Chinese and Japanese seas, near the Antilles, and in many other places of the ocean, particularly in the neighbourhood of prominent coasts. But they are still more frequent upon land; and their effects are sometimes prodigious. 'I have 'seen,' says Bellarmin, (De Ascensu Mentis in Deum,) 'an enormous ditch scooped out by the wind, transported 'in the air, and dropped upon a village, which was for 'ever buried under this load of earth.' A detail of the effects of several hurricanes may be seen in the history of the French Academy, and in the Philosophical Transactions, which would appear altogether inconceivable, if they were not attested by intelligent and credible spectators.

The same observation may be made with regard to water-spouts, which the mariner never beholds without terror and amazement. They are common on certain coasts of the Mediterranean, especially when the weather is cloudy, and the wind blows from several quarters at the same time. They are more frequent near the coasts of Laodicea, of Greggo, and of Carmel, than in any other part of the Mediterranean. Most of them are large cylinders of water which fall from the clouds, though, at a distance, the water appears to rise up from the sea to the clouds. (See Shaw's Travels.)

But there are two species of water-spouts; the first is that we have just mentioned, and is nothing but a thick cloud compressed, and surrounded by opposite winds blowing from different quarters at the same time, which make it assume a cylindric figure, and fall down by its own gravity. The quantity of water is so immense, and the rapidity of the fall so great, that if, unfortunately, one of these spouts break upon a ship, it is dashed to pieces, and sinks in an instant. It is alledged, and with probability, that water-spouts may be broken and dissipated by the commotion excited in the air by the firing of cannons, which corresponds with the dissipation of thunder-clouds by the ringing of bells.

The other species of water-spout is called a *typhon*, and is very frequent in the Chinese Sea. The typhon descends not from the clouds, nor is it produced by the action of opposite winds. On the contrary, it rises from the water to the heavens with amazing rapidity. Whirlwinds often run along considerable tracts, bearing down houses, trees, and every obstacle they meet with. But typhons remain always in the same places, and can be owing to nothing but subterraneous fires; for the sea is then in the greatest agitation, and the air is so impregnated with sulphureous exhalations, that the sky appears to be covered with a copper-coloured crust, although there be no clouds, and the sun or the stars appear through the vapour. It is to these subterranean fires that we must ascribe the warmth of the Chinese Sea in winter, where these typhons are very frequent. (See Acta erud. Lips. supplem. tom. i. p. 405.)

Thevenot, in his voyage to the East, gives the following account of water-spouts: 'We saw water-spouts in 'the Persic Gulf, between the islands of Quesmo, La 'reca, and Ormuz. Few have had the opportunity of 'observing, and fewer still have paid the attention to 'water-spouts, that I have done. I shall describe them 'with perspicuity and simplicity, in order to render my 'account the more intelligible.

'The first that we saw, was on the north side between 'us and the island of Quesmo, about a gun-shot from

'our ship. In this place, we saw the water begin to 'boil, and to be raised about a foot above the surface: it 'was whitish, and the top of it appeared like black 'smoke: it made a kind of whispering noise, like a tor- 'rent rushing down with violence into a deep valley. 'This noise was mingled with another that resembled 'the hissing of serpents. A little afterwards, we saw an 'obscure canal or pipe, which resembled smoke rising 'to the clouds, and revolved with considerable velocity: 'this pipe was about the size of a man's finger; and the 'same noise continued. It then vanished, having con- 'tinued in all about a quarter of an hour. We then 'perceived another on the south, which began in the 'same manner as the former: immediately a third sprung 'up to the west, and then a fourth likewise to the west; 'the most distant from us not exceeding a musket-shot. 'Each of them appeared like heaps of smoking straw, 'and were accompanied with the same noise as the first. 'We next perceived three pipes, or canals, extending 'from the water to the clouds, where each of them ter- 'minated like the mouth of a funnel or trumpet, or like 'the paps of an animal drawn perpendicularly downward 'by a weight. These pipes were of a dark white co- 'lour, which I imagined to be owing to the water 'they contained; for the pipes appeared to be formed 'before they were filled with the water, and they disap- 'peared when they were empty; in the same manner as 'a cylinder of clear glass, when held up in the light at a 'distance from the eye, is not visible, unless it be filled 'with some coloured liquor. These pipes were not 'straight, but bent in some places: they were not even 'perpendicular; on the contrary, from the clouds into 'which they were ingrafted, to the places from which 'they extracted the water, they were very much inclined. 'And, what is singular, the cloud to which the second 'of the three was attached, having been pushed forward 'by the wind, the pipe followed it without breaking, or 'quitting its station in the water; and, passing behind 'the pipe of the first, they remained for some time in 'the form of a St. Andrew's cross. At first, none of the 'three exceeded an inch in thickness, except where they 'joined the cloud: but the one that appeared first, 'swelled afterwards considerably. The other two con- 'tinued not longer than the one we had seen to the 'north. The second, on the south, lasted about a 'quarter of an hour; but the first, on the same side of 'the vessel, continued longer, and gave us some uneasi- 'ness. Concerning it, therefore, we have still farther to 'remark, that, although it originally was not larger than 'a man's finger, it gradually swelled to the size of an 'arm, then to that of a leg, and, *lastly*, to that of the 'trunk of a tree as large as a man could encompass with 'both his arms. We saw the water rising distinctly 'through this transparent body, which was of a serpen- 'tine form; and it sometimes diminished in thickness 'both above and below. It now exactly resembled a 'soft tube filled with water, and pressed with the fin- 'gers, either above to make the fluid descend, or below 'to make it ascend; and I was satisfied that these va- 'riations were occasioned by the wind, which, when it 'pressed the canal above, caused the water to descend, 'and when the pressure was lower down made the water 'ascend. After this, it diminished to the size of a 'man's arm; then it swelled to the size of a thigh; 'then became exceedingly small; *lastly*, I perceived that 'the water elevated from the surface began to sink, and 'the end of the canal separated from it; when a varia- 'tion of the light removed it from my view. I still, 'however, continued to look for it, because I had re- 'marked, that the canal of the second spout appeared to 'break in the middle, and to reunite a little afterwards, 'one half of it having been concealed by the light; but 'this last never more appeared.

'These spouts are exceedingly dangerous at sea; for, 'when they fall upon a vessel, they mingle so with the 'sails, that they sometimes raise the vessel up, and let 'it fall back again with such violence as to sink it. But, 'although they should not raise the ship, they tear the 'sails, or let the whole water they contain fall upon the 'vessel, which precipitates it to the bottom. It is not 'improbable, that many vessels, of which we never have 'any accounts, perish by such accidents; for there are 'few examples of our ever learning with certainty of 'ships being lost in this manner.'

The above account of water-spouts seems to have proceeded from several optical illusions. But I have related the facts *verbatim*, that they may either be confirmed, or at least compared with those of other navigators. M. Gentil, in his voyage round the world, describes water-spouts in the following manner: 'At 'eleven o'clock, before noon, the sky being cloudy, we 'saw round our ship, at the distance of about a quarter 'of a league, six water-spouts, which began with a 'noise like that of water running below ground, and 'gradually increased till it resembled the hissing noise 'occasioned by a high wind among the ropes of a ship. 'We first perceived that the sea began to boil; and its 'surface rose about a foot and a half; the top of this 'elevated part was covered with a thick fog, or rather 'smoke, which formed itself into a canal, and mounted 'to the clouds. These canals bended according as the 'wind carried the clouds to which they were attached. 'Notwithstanding the motion communicated to the 'clouds by the wind, the canals not only adhered to 'them, but seemed to stretch out, or contract, in pro- 'portion as the clouds rose higher, or sunk down in the 'atmosphere.

'These appearances gave us much uneasiness; and 'our sailors, instead of encouraging each other, increased 'their fears by dreadful stories. If these spouts, said

'they, fall upon the ship, they will lift her up, and then 'plunge her to the bottom. Others maintained, with a 'decisive tone, that they would not lift the vessel; but 'that, being full of water, if the ship went forward, she 'would break their communication with the sea, and 'that the great body of water, by falling perpendi-'cularly on the vessel, would break her in pieces.

'To prevent this misfortune, they lowered the sails, 'and charged the cannon. It is a general opinion among 'sailors that the firing of cannon, by agitating the air, 'bursts and disperses water-spouts. But we were not 'under the necessity of having recourse to this expe-'dient; for, after coursing round the ship for about ten 'minutes, some being about a quarter of a league from 'us, and others nearer, the canals became gradually 'narrower, detached themselves from the surface of the 'sea, and then entirely vanished.' (Tom. i. p. 191.)

From the description of these two voyagers, it appears, that water-spouts are produced, at least in part, by the action of fire or smoke, which rises with violence from the bottom of the sea; and that they are very different from those which are occasioned by opposite winds: 'The 'water-spouts,' says Mr. Shaw, 'which I had the oppor-'tunity of seeing, seemed to be so many cylinders of 'water falling down from the clouds; though, by the 'reflection, it may be of those descending columns, or 'from the actual dropping of the water contained in 'them, they would sometimes appear, especially at a 'distance, to be sucked up from the sea. Nothing more 'perhaps, is required to explain this phænomenon, than 'that the clouds should be first of all crowded together, 'and then, that contrary winds, pressing violently upon 'them, should occasion them to condense, and fall in 'this cylindrical manner.' (Shaw's Travels, p. 334.)

Many facts remain still to be known before these phænomena can be properly explained. To me it appears, that, if there be, in particular places, at the bottom of the sea, a mixture of sulphur, bitumen, and mineral substances, these may occasionally be inflamed, which will produce, like the explosion of gun-powder, a great quantity of air; and that this air newly generated, and rarefied to a prodigious degree, mounts with rapidity, and may elevate the water from the sea to the clouds. In the same manner, if a perpendicular current of air be produced by the explosion of sulphureous matter in a cloud, the whole of its water may follow this current, and give rise to a water-spout from the clouds to the sea. But, it must be acknowledged, that this account of the last species of spout is not more satisfactory than that which we have given of those produced by contrary winds; for it may be asked, why those spouts, which originate from the clouds, are not as common on land as upon the sea.

The historian of the academy for the year 1727, mentions a land water-spout that appeared at Capestan near Bezieres. It descended from a cloud like a black pillar, which gradually diminished, and ended in a point upon the surface of the earth. It followed the direction of the wind, which was westerly; it was attended with a thick smoke, and made a noise like the sea when greatly agitated. It tore up trees by the roots, and marked its way on the earth by a large tract in which three carriages might have passed each other. Another pillar of the same kind appeared, but it soon joined the first; and, when the whole was dissipated there fell a great quantity of hail.

This species of water-spout appears to be different from the other two. It is not said to have contained water; and it seems, both from what I have mentioned, and by M. Andoque's explication of it to the academy, to have been only a hurricane rendered visible by the dust and condensed vapour which it contained. The same historian, for the year 1741, mentions a water-spout which was seen upon the lake of Geneva. It was of a cylindrical figure, the upper part of which ended in a black cloud, and the under part of it was narrow, and terminated near the surface of the water. This meteor continued only a few minutes; and, at the moment of its dissipation, a thick vapour ascended from the place where it first appeared; the water of the lake boiled, and seemed to make an effort to rise into the air, which was very calm the whole time; neither was this spout followed either by wind or rain. 'After all our know-'ledge of water-spouts,' says the historian, 'does not 'this prove that they are not produced by the conflict of 'opposite winds alone, but that they almost always ori-'ginate from volcanoes or subterraneous vapours, which 'are known to exist at the bottom of the sea, as well as 'upon land? Whirlwinds and hurricanes, therefore, 'which are generally believed to be the cause of these 'appearances, may be only an effect or an accidental con 'sequence of them.'

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XVI.

Of Volcanoes and Earthquakes.

THE bowels of those burning mountains called *volcanoes* contain sulphur, bitumen, and other inflammable materials, the effects of which are more violent than those of thunder or of gun-powder; and they have, in all ages, astonished mankind, and desolated the earth. A volcano is an immense cannon, with an aperture often more than half a league in circumference. From this vast mouth are projected torrents of smoke and of flames, rivers of bitumen, of sulphur, and of melted metals, clouds of ashes and stones; and sometimes it ejects, to the distance of several leagues, rocks so enormous, that they could not be moved by any combination of human force. The conflagration is so dreadful, and the quantities of burning, calcined, melted, and vitrified substances, thrown out by the mountain, are so great, that they bury whole towns and forests, cover the plains to the thickness of a hundred or two hundred feet, and sometimes form hills and mountains, which are only portions of these matters heaped up and compacted into one mass. The action of the fire and the force of the explosions are so violent, that they produce, by re-action, succussions, which shake the earth, agitate the sea, overturn mountains, and destroy towns and buildings of the most solid materials.

These effects, though natural, have been regarded as prodigies; and, though we often behold, in miniature, effects similar to those of volcanoes; yet grandeur, from whatever source it proceeds, has such an astonishing influence upon the imagination, that it is not surprising they should have been considered by some authors as vents to a central fire, and, by the vulgar, as mouths of hell. Astonishment produces fear, and fear is the source of superstition. The inhabitants of Iceland believe that the groanings of their volcano are the cries of the damned, and that its eruptions are occasioned by the desperation and ungovernable fury of devils and tormented spirits.

All these phænomena, however, are only the effects of fire and of smoke. In the bowels of mountains, there are veins of sulphur, bitumen, and other inflammable substances, together with vast quantities of pyrites, which ferment when exposed to the air or moisture, and produce explosions proportioned to the quantity of inflammable matter. This is the true idea of a volcano; and it is easy for the naturalist to imitate the operation of these subterraneous fires. A mixture of sulphur, of filings of iron, and of water, buried at a certain depth below the ground, will exhibit, in miniature, all the appearances of a volcano: this mixture soon ferments to a degree of inflammation, throws off the earth and stones which cover it, and produces explosions every way similar to those of burning mountains.

The most famous volcanoes in Europe are those of Mount Ætna in Sicily, of Mount Hecla in Iceland, and of Mount Vesuvius, near Naples in Italy. The burning of Mount Ætna is more ancient than the records of history. Its eruptions are extremely violent; and the quantity of matter it throws out is so enormous, that, after digging 68 feet deep, marble pavements, and other vestiges of an ancient city, have been found covered with this amazing load of ejected matter, in the same manner as the town of Herculaneum has been buried with the matter thrown out from Mount Vesuvius. New mouths, or craters, were opened in Ætna, in the years 1650, 1669, and at other times. The smoke and flames of this volcano are seen as far as Malta, a distance of 60 leagues. It sends forth a perpetual smoke, and, at particular times, it throws out with astonishing violence, flames, lava, huge stones, and matter of every kind. An eruption of this volcano, in the year 1537, produced an earthquake over the whole island of Sicily, which lasted 12 days, and overthrew an immense number of houses and public buildings. It terminated by the bursting of a new mouth, the lava of which burnt up every thing within five leagues of the mountain. It discharged ashes so abundantly, and with such force, that they reached the coast of Italy, and incommoded vessels at great distances from the island. This volcano has, at present, two principal craters, one of which is narrower than the other. They both smoke perpetually; but flames only appear during the time of eruptions. Large stones, it is said, have been projected from them to the distance of 60,000 paces.

A violent eruption, in 1683, produced a dreadful earthquake in Sicily. It laid the whole city of Catanea

in ruins, and destroyed more than 60,000 of its inhabitants, beside those who perished in the neighbouring towns and villages.

Hecla darts its fires through the snows and ice of a frozen climate. Its eruptions, however, are equally violent with those of Ætna, and other volcanoes in the more southern regions. It throws out ashes, lava, pumice-stones, and sometimes boiling water. The whole island of Iceland abounds in sulphur; but it is not habitable within less than six leagues of the volcano. The history of its most violent eruptions is recorded in a book written by *Dithmar Bleffken.*

According to historians, the burning of Mount Vesuvius began not before the seventh consulate of Titus Vespasian and Flavius Domitian. The top of the mountain then opened, and at first threw out stones and rocks. These were succeeded by flames and lava which burnt up two neighbouring cities, and volumes of smoke so thick as to darken the light of the sun. The elder Pliny, stimulated by curiosity, approached too near the mountain, and was suffocated by its sulphureous steams. (See Pliny the younger's letter to Tacitus.) Dion Cassius relates, that this eruption was so violent, that ashes and sulphureous steams were transported as far as Rome, and across the Mediterranean into Africa and Egypt. Heraclea was one of the cities that were overwhelmed by the matter ejected from the mountain: it has lately been discovered 60 feet under the surface of the ground, which, in the course of time, had become arable and fit for every kind of culture. The history of the discovery of Heraclea is in the hands of the public. We have only to wish, that some person, skilled in the knowledge of nature, would examine with attention the different materials which compose these 60 feet of earth, and remark their situation, the alterations they have undergone, the direction they have followed, the hardness they have acquired, &c.

Naples appears to be situated upon a vault, filled with burning minerals; for Vesuvius and Solfatara seem to have subterraneous communications. When Vesuvius throws out lava, Solfatara emits flames; and, when the eruptions of the former cease, the burning of the latter is likewise extinguished. The city of Naples is nearly in the centre between them.

One of the last and most dreadful eruptions of Vesuvius happened in the year 1737. [This volume was published in the year 1749. Several eruptions have happened since that time. See Hamilton's History of Vesuvius.] The mountain discharged, from several mouths, immense torrents of melted matter, which spread over the fields, and terminated in the sea. M. de Montealegre, who communicated this account of it to the Academy of Sciences, observed, with horror, one of these rivers of fire, which, from its source to the sea, was about 7 miles in length, 50 or 60 paces broad, from 25 to 30 palms deep, and in the valleys 120 palms. The running matter resembled foam, or the dross which issues from a furnace, &c. (See l'Hist. de l'Acad. année 1737, p. 7.)

In Asia, and particularly in the islands of the Indian Ocean, volcanoes are numerous. One of the most famous is Mount Albours, near Mount Taurus, about 8 leagues from Herat. The top of this mountain sends forth a perpetual smoke; and it frequently throws out flames and burning matter, in such quantities as to cover all the adjacent plains with ashes. In the island of Ternate, there is a volcano which discharges matter similar to pumice-stones. Some voyagers alledge, that this volcano is most furious during the equinoxes, because these periods are attended with certain winds which increase the inflammation of those fires that have continued to burn for ages. (See Voyages d'Argensola, tom. i. p. 21.) The island of Ternate is not above 7 leagues round, and is only the top of a large mountain. The land rises from the coast to the middle of the island, where the volcano mounts to a height so great, that it is difficult to climb to its top. Several rills of sweet water descend from the sides of the mountain; and, when the air is calm, and the weather fine, this burning gulf is less agitated than during storms and high winds. (See Voyage de Schouten.) This is a confirmation of what I formerly remarked, and seems to prove, that the fire of volcanoes proceeds not from a great depth, but from the top or higher parts of the mountain; for, if it were otherwise, high winds could not increase the violence of the flames.

There are other volcanoes in the Molucca Islands. In one of the islands of Mauritius, about 70 leagues from the Moluccas, there is a volcano, the effects of which are equally violent as those of the mountain in Ternate. The island of Sorca, one of the Moluccas, was formerly inhabited. In the middle of this island there is a very high mountain, with a volcano at its summit. In 1693, this volcano discharged an immense quantity of bitumen, and inflamed matter, which, after forming a burning lake, gradually extended till it covered the whole island. (See Phil. Trans. abridg. vol. ii. p. 391.)

There are several volcanoes in Japan, and the adjacent islands, which send out flames in the night, and smoke in the day. In the Philippine islands, there are likewise several burning mountains. One of the most remarkable, and, at the same time, the most recent volcano in the Indian islands, is that near the town of Panarucan in the Island of Java. It commenced in the year 1586, and, at the first eruption, it threw out immense quantities of sulphur, bitumen, and stones. The same year, Mount Gounapi, in the Island of Banda, which had been a volcano about 17 years only, opened and ejected, with a dreadful noise, rocks and matter of every kind.

There are still other volcanoes in India, as in Sumatra, and in the north of Asia, beyond the river Jeniscea, and the river Pesida: but the two last are little known.

Near Fez in Africa, there is a mountain, or rather a cavern, called *Beni-guazeval*, which constantly throws out smoke, and sometimes flame. One of the Cape de Verd islands, called the island of *Fuogo*, is nothing but a huge mountain which burns incessantly. This volcano throws out stones and ashes; and the Portuguese, who often attempted to inhabit the island, have always abandoned the project, on account of the volcano. The Peak of Teneriff, which is reckoned one of the highest mountains in the world, throws out fire, ashes, and large stones. From the top of it, rivulets of melted sulphur run down the south side across the snows. This sulphur soon condenses, and forms veins in the snow, which are distinguishable at great distances.

America, and particularly the mountains of Mexico and Peru, are much infested with volcanoes. That of Arequipa is one of the most celebrated: it often produces great earthquakes, which are more frequent in Peru than in any country of the world. Next to Arequipa, the volcanoes of Carrapa and Malahallo are, according to the relation of travellers, the most considerable. But there are many others in the new world of which we have no knowledge. M. Bouguer, in his voyage to Peru, published in the Memoirs for the Academy for the year 1744, mentions two volcanoes, the one called *Cotopaxi*, and the other *Pichincha*. The first is at some distance from, and the other very near, the town of Quito. In 1742, he saw an eruption of Cotopaxi, which, at that time, burst open a new mouth in the mountain. It did no other damage than that of melting the snow, and producing such torrents, as, in three hours, laid the whole country, to the extent of 18 leagues, under water, and overturned every thing in their course.

Popochampeche and Popocatapec are the chief volcanoes in Mexico. It was near this last that Cortes passed in his way to the city of Mexico. Some of the Spaniards ascended to the top of the mountain, where they found the crater to be about half a league in circumference. Sulphureous mountains have also been found in Guadaloupe, Tercera, and in others of the Azore Islands; and, if all the mountains from which smoke or flames issue were to be considered as volcanoes, their number would exceed 60. We have only mentioned those which are so formidable, as, by their frequent eruptions, to prevent people from living near them.

The numerous volcanoes in the Cordeliers, as I formerly remarked, produce almost perpetual earthquakes, which prevent the inhabitants from building with stone any higher than the first floor; and the upper part of their houses, for the same reason, are constructed with rushes or very light wood. In these mountains there are also many precipices and large gulfs, the walls of which are black and burnt. They are similar to the precipice of Mount Ararat in Armenia, called the *Abyss*, and are the craters of extinguished volcanoes.

A late earthquake at Lima was attended with the most dreadful effects. The town of Lima, and the port of Callao, were almost entirely swallowed up. But the mischief was still more terrible at Callao. The sea rose and covered every house in that unfortunate town, and drowned the whole inhabitants, leaving only a single tower as a monument of its devastations. Of 25 vessels which lay in the harbour, four were driven a league upon land, and the rest were swallowed up by the waves. Of Lima, which was a very large city, only 27 houses remained standing. Multitudes of people perished; and the disaster was particularly fatal to the monks and other religious, because their buildings were lofty and of more solid materials than the common houses. This calamity happened in October 1746, during the night; and the succussion lasted 15 minutes.

Near the port of Pisca, in Peru, there was formerly a famous city, situated on the sea-coast; but, on the 19th of October, 1682, it was almost entirely destroyed by an earthquake; for the sea, having exceeded its usual limits, sweeped away this unfortunate city, with all its inhabitants.

By consulting historians and travellers, we shall find many accounts of earthquakes, and eruptions of volcanoes, equally dreadful and destructive as those we have mentioned. Pesidonius, quoted by Strabo, (Lib. i.) relates, that a city of Phœnicia, near Sidon, was swallowed up by an earthquake, with the neighbouring territory, and two-thirds of Sidon itself; that this effect was not produced so suddenly as to hinder the inhabitants from escaping by flight; that it extended over most of Syria, and as far as the Cyclades Islands and Eubœa, where the fountains of Arethusa suddenly stopped, and appeared a few days afterwards by new sources at a considerable distance from the old; and that the earthquake continued to shake the island sometimes in one place, and sometimes in another, till the earth opened in the valley of Lepanta, and discharged a great quantity of burning matter. Pliny informs us, (Lib. i. c. 84.) that, in the reign of Tiberius, twelve cities in Asia were overturned; and he mentions, (Lib. ii. c. 83.) in the following terms, a prodigy occasioned by a violent earthquake. 'Factum est semel (quod equidem in Etruscæ 'disciplinæ voluminibus inveni) ingens terrarum por- 'tentum, Lucio Marco, Sex. Julio Coss. in agro Muti- 'nensi. Namque montes duo inter se concurrerunt, 'crepitu maximo adsultantes recedentesque, inter eos 'flamma, fumoque in cœlum exeunte interdiu, spec- 'tante è via Æmilia magna equitum Romanorum fami- 'liarumque et viatorum multitudine. Eo concursu 'villæ omnes elisiæ, animalia permulta, quæ intra fue-

'runt, exanimata sunt,' &c. St. Augustin tells us, (Lib. ii. de Miraculis, c. 3.) that, in Lybia, 100 towns were destroyed by an earthquake. In the time of Trajan, the earth opened and devoured the city of Antioch, and a great part of the adjacent country. It was again destroyed by the same cause during the reign of Justinian in the year 528, and 40,000 of its inhabitants perished. It was visited with a third earthquake in the days of St. Gregory, sixty years after the former, which destroyed no less than 60,000 of its inhabitants. In the reign of Saladin, *anno* 1182, most of the cities of Syria and of Judea were laid waste by the same calamity. Earthquakes have been more frequent in Apulia and Calabria than in any other part of Europe. In the time of Pope Pius II. all the churches and palaces of Naples were thrown down, and about 30,000 lives were lost: those who escaped were obliged to live in tents till houses were built for them. In 1629, 7000 persons perished in Apulia by earthquakes; and, in 1638, the city of Saint Euphemia was swallowed up, and left behind it nothing but a stinking lake: at the same time, Ragusa and Smyrna were almost totally destroyed. In 1692, an earthquake was felt in Britain, Holland, Flanders, Germany, and France: it was most severe along the coasts of the sea, and near great rivers. It agitated at least 2600 square leagues, though it lasted but two minutes. The commotion was greater in the mountains than in the valleys. (See Ray's Discourses, p. 272.) On the 10th of July, 1688, there was an earthquake at Smyrna, which began with a motion from west to east. The castle was first overturned; its four walls separated from each other, and sunk six feet in the sea. This castle stood formerly on an isthmus, which is now a real island, about 100 paces from the land. The east and west walls fell; but the north and south walls still remain. The city, which is near ten miles from the castle, was overthrown soon after. The earth opened in many places, attended with subterraneous noises; and five or six dreadful shocks were felt before the approach of night, the last of which lasted about half a minute. The ships in the roads were greatly agitated; the ground on which the town stood sunk two feet; and not above a fourth of the houses withstood the concussion, and those were mostly founded on rock. From fifteen to twenty thousand lives were lost. (See l'Hist. de l'Acad. des Sciences, ann. 1688.) In 1695, an earthquake was felt at Bologna in Italy; and it was remarked, as a singular phænomenon, that the sea was much troubled the day preceding. (Ibid ann. 1696.)

'On the 4th of May, 1614, a terrible earthquake happened at Tercera, which, beside private houses, overturned eleven churches and nine chapels in the city of Angra; and the city of Praya was so much shaken, that hardly a house was left standing: and, on the 15th of June, 1628, the island of St. Michael was visited with a great earthquake. Near this island, in the open sea, there arose a new island in a place where the water was 150 fathoms deep. This island was more than a league and a half long, and above six fathoms high. (See Mandelslo's Voyages.)

'In the island of St. Michael, another earthquake began on the 26th of July, 1691, and continued to the 12th of the following month. Tercera and Fayal were shaken next day with such violence, that they seemed to turn about. These concussions, however, were repeated there only four times: but at St. Michael, they ceased not a moment during the space of eleven days. The islanders abandoned their houses, which every where tumbled down before their eyes, and remained the whole time in the open fields, exposed to the injuries of the weather. The whole town of Villa Franca was overturned to the foundation, and most of the inhabitants were buried under its ruins. In several places, the plains were elevated into hills, and, in others, the hills sunk down into valleys. A fountain of fresh water issued from the ground, and run for four days, and then stopped all of a sudden. The air and the sea were in such commotion, that they made a noise resembling the bellowings of ferocious animals. Many people died of fear. There was not a vessel in the harbours which was not agitated in a dangerous manner; and those which lay at anchor, or were under sail, at the distance of twenty leagues, were still more severely tossed. Earthquakes are very frequent in the Azores: twenty years before the period mentioned, a mountain in St. Michael was overturned by a dreadful earthquake. (Gen. Hist. of Voyages, vol. i. p. 325.)

'In the month of September, 1627, an earthquake levelled one of the two mountains of Manilla, called *Carvalos*, in the province of Cagayon. In 1645, a third part of the city was destroyed by a similar accident, and 300 persons perished in the ruins. The following year it was visited by another; and the old Indians tell us, that earthquakes are now less destructive than formerly; but they still build their houses of wood, in which they are imitated by the Spaniards.

'The number of volcanoes in this island confirms the above relation; for, at certain intervals, they vomit forth flames, shake the earth, and produce all the effects ascribed by Pliny to the eruptions of Vesuvius, such as changing the beds of rivers, making the neighbouring parts of the sea retreat, covering the places adjacent with ashes, projecting stones to great distances, and making reports louder than those of cannons.' (See Voyage de Gemelli Careri, p. 129.)

'In 1646, an earthquake split a mountain in the island of Machian, and the explosion made a frightful noise. From the cleft issued such a quantity of flames as consumed several plantations with their inhabitants. This prodigious aperture was to be seen in the year 1685,

'and it probably remains to this day. It was called the 'Wheel-track of Machian, because it ran from the top 'to the bottom of the mountain, and, at a distance, had 'the appearance of a high road.' (See l'Hist. de la Conquete des Moluques, tom. iii. p. 318.)

The History of the French Academy mentions, in the following terms, the earthquakes which happened in Italy during the years 1702 and 1703. 'They began 'in October, 1702, and continued till July, 1703. The 'city of Norcia, with its dependencies in the ecclesiastical 'state, and the province of Abruzzo, suffered most: and 'the earthquakes were first felt in those places which 'are situated at the foot of the Appennines, on the south 'side.

'They were frequently accompanied with frightful 'noises in the air, and these noises were sometimes 'heard when the earth was at rest, and the sky serene. 'The most violent concussion was on the 2d of February, '1703; and it was attended, especially at Rome, with 'a remarkably clear sky, and a great calmness in the air. 'At Rome it lasted half a minute, and at Aquila, the 'capital of Abruzzo, three hours. Beside ravaging the 'neighbouring country, it destroyed the whole town of 'Aquila, and buried 5000 persons under its ruins.

'The concussions, or vibrations of the earth, as was 'discovered by the motion of the lamps in the churches, 'were nearly from south to north.

'The earth opened in two places, and discharged, 'with violence, great quantities of stones, which covered 'a whole field, and rendered it barren. After the 'stones, these apertures threw up water above the eleva- 'tion of the highest trees. This discharge continued a 'quarter of an hour, and laid the neighbouring country 'under water. The water was whitish, like soap-suds, 'and had no particular taste.

'On the top of a mountain near Sigillo, a village 'about 22 miles from Aquila, there was a considerable 'plain surrounded with rocks like a wall. The earth- 'quake of the 2d of February converted this plain into 'a large unequal gulf, its greatest diameter being 25 'fathoms, and its least 20. This gulf has been sounded 'with ropes of 300 fathoms, without reaching the 'bottom. At the time that the gulf was formed, flames 'were observed to issue out of the mountain, and after- 'wards a thick smoke, which continued, with some inter- 'ruptions, for three days.

'At Genoa they had two slight concussions, of the '1st and 2d days of July, 1703, the last of which was 'only felt by the people on the Mole. The sea, at the 'same time, sunk 6 feet in the port, and continued in 'this situation a quarter of an hour.

'The sulphureous water on the road between Rome 'and Tivoli sunk two feet and a half, both in the basin 'and in the canal. The springs and rills of water, which 'rendered many places of the plain called *Testine* marshy, 'were entirely dried up. The depth of the water in the 'lake called *l'Enfer* was diminished three feet. In 'place of the old springs, new ones, about a mile dis- 'tant, appeared: they are probably the same waters, the 'courses of which have been changed by the concussion 'of the earth.' (See l'Hist. de l'Acad. des Sciences, ann. 1704.)

The same earthquake, which, in 1538, formed the Monti de Cinere near Puzzoli, filled the Lucrin lake with stones, earth, and ashes, and converted it into a marsh. (See Ray's Discourses, p. 12.)

'Earthquakes, also,' says Mr. Shaw, 'have sometimes 'been felt at sea. In the year 1724, when I was aboard 'the Gazella, an Algerine cruiser of 50 guns, bound to 'Bona to relieve the garrison, we felt three prodigious 'shocks, one after another, as if a weight, at each time, 'of 20 or 30 ton, had fallen from a great height upon 'the ballast. This happened when we were five leagues 'to the southward of the Seven Capes, and could not 'reach ground with a line of 200 fathom. The captain 'told me, that, a few years before, when he was upon a 'cruise, he felt a much greater one, at the distance of '40 leagues to the westward of the rock of Lisbon.' (Shaw's Travels, p. 151.)

Schouten, speaking of an earthquake which happened in the Moluccas, says, that the mountains were shaken, and that the vessels at anchor in 30 or 40 fathom water, were shocked, as if they had run ashore, or struck against rocks. 'We learn,' continues he, 'from daily experi- 'ence, that the same happens in the ocean, where no 'bottom can be found; and that earthquakes agitate 'vessels, even when the sea is perfectly calm.' (Voyages, vol. vi. p. 103.)

Gentil, in his voyage round the world, has the follow- ing remarks upon earthquakes: '1. That, half an hour 'before the earth begins to shake, all animals appear to 'be seized with a panic. The horses neigh, break their 'halters, and run out of the stable; the dogs bark; the 'birds, as if stupid, fly for shelter into the houses; the 'rats and mice come out of their holes, &c. 2. That 'ships at anchor are so violently agitated, that all the 'parts of which they are composed seem to be torn 'asunder; their guns break loose, and their masts 'spring: these facts I should hardly have credited, if 'they had not been confirmed to me by the unanimous 'testimony of many witnesses. I know that the bottom 'of the sea is a continuation of the land; and that agi- 'tations of the one must be communicated to the other; 'but I could not comprehend how the different parts of 'a vessel, swimming in a fluid, should be affected in the 'same manner as if she had been resting on the ground. 'Her motion, I imagined, should have only resembled 'that produced by a storm; besides, in the present in- 'stance, the surface of the sea was smooth, and the 'whole agitation must have proceeded from some internal

'cause, because, at the time of the earthquake there was 'no wind. 3. That, if the cavern of the earth which 'contains the subterraneous fire, runs from north to 'south, and if the buildings of a town above it lie in the 'same direction, the whole houses are overturned; but, 'if the vein or cavern runs across the town, the damage 'produced by the earthquake is less considerable. (See Voyage de M. le Gentil, tom. i. p. 172.)

When a new volcano breaks out in countries subject to earthquakes, they almost entirely cease, and are seldom felt, except during great eruptions, as has been observed with regard to the island of St. Christophers. (See Phil. Trans. abridg. vol. ii. p. 392.)

The enormous ravages produced by earthquakes have induced some naturalists to imagine, that mountains and all the other irregularities on the surface of the globe, have derived their origin from succussions of the earth, occasioned by the action of subterraneous fires. This, for instance, is the opinion of Mr. Ray. He believes that all the mountains have been formed by earthquakes, or by the explosions of volcanoes, in the same manner as Monti di Cinere in Italy, the new island near Santorini, &c. But he has not considered, that the small elevations formed by earthquakes, or by the eruptions of volcanoes, are not, like all other mountains, composed of horizontal strata; for, by digging into the Monti de Cinere, we find calcined stones, ashes, burnt earth, iron-dross, pumice-stones, all blended together like a heap of rubbish. Besides, if earthquakes and subterraneous fires had raised the great mountains of the earth, as the Cordeliers, Mount Taurus, the Alps, &c. the prodigious force requisite to elevate these enormous masses would, at the same time, have destroyed a great part of the surface of the globe. Earthquakes sufficient to produce such effects must have been inconceivably violent, since the greatest of them recorded in history have not been able to produce a single mountain. In the reign of Valentinian I. for instance, an earthquake was felt over the whole known world, (Ammian. Marcellin. lib. xxvi. c. 14.) and yet it raised not a single mountain.

It is capable of demonstration, however, that, though an earthquake should have a force sufficient to raise the highest mountains, this force would not be able to displace the rest of the globe.

For, let it be supposed, that the chain of high mountains which traverse South America, from the point of Terra Magellanica to New Granada, and the Gulf of Darien, had been suddenly elevated by an earthquake, and then let us estimate the effect of this explosion. This chain of mountains is about 1700 leagues long, and, at a medium, 40 leagues broad, including the Sierres, which are lower than the Andes. This gives a surface of 68,000 square leagues. The thickness of the matter displaced by the earthquake I suppose to be one league; or, that the mean height of the mountains from their summits to the caverns, which, agreeable to this hypothesis, must support them, is one league. The force of the explosion, therefore, must have elevated, to the height of a league, a quantity of earth equal to 68,000 cubic leagues. But, action and re-action being equal, this explosion must have communicated an equal quantity of motion to the whole globe. Now, the whole globe consists of 12,310,523,801 cubic leagues. From this number take 68,000, and there remains 12,310,455,801 cubic leagues, of which the quantity of motion would be equal to that of 68,000 elevated one league. Hence it appears, that the force necessary to raise 68,000 cubic leagues would not be sufficient to displace the whole globe a single inch.

There is no absolute impossibility, therefore, in the supposition, that the mountains have been raised by earthquakes, were it not evident, both from their internal structure and their external figure, that they have been formed by the operation of the waters of the ocean. Their interior parts are composed of parallel strata, interspersed with sea-shells; and their external figure consists of angles every where corresponding. Is it credible that this uniform structure, and regular figure, could have been produced by sudden and desultory succussions of the earth?

But, as this notion has been embraced by some philosophers, and, as the nature and effects of earthquakes are not well understood, I shall hazard a few ideas, which may perhaps throw some light upon this intricate subject.

The surface of the earth has undergone many changes. At considerable depths, we find holes, caverns, subterraneous rivulets, and voids, which sometimes communicate with each other by means of chinks and fissures. There are two species of caverns: the first are those which have been formed by volcanoes and the action of subterraneous fires. The action of subterraneous fire elevates, shakes, and throws off to a distance the superincumbent materials; at the same time, it splits and deranges those on each side of it, and thus produces caverns, grottos, and irregular hollows. But such effects are only exhibited in the neighbourhood of volcanoes, and are not so frequent as the other species of caverns which are produced by the operation of water. It has already been remarked, that the different strata of the earth are all interrupted by perpendicular fissures, the origin of which shall be afterwards explained. The waters which fall upon the surface descend through those fissures, collect when their progress is prevented by a stratum of clay, and form springs and rivulets. From the nature of water, it searches for cavities or small vacuities, and has a constant tendency to force a passage, till it finds a proper vent. Wherever it goes, it carries along with it sand, gravel, and other bodies which it is capable of dividing or dissolving. In this manner the operation

of water proceeds, till it forms subterraneous passages; and then it breaks out in the form of fountains, either on the surface of the earth, or in the bottom of the sea. The materials it perpetually carries off leave hollows or caverns in the bowels of the earth, which are often of great extent; and these caverns have a very different origin from those produced by volcanoes or earthquakes.

Earthquakes are of two kinds: those occasioned by the action of subterraneous fires, and by the explosions of volcanoes, are only felt at small distances, previous to, or during the time of eruptions. When the inflammable matters in the bowels of the earth begin to ferment and to burn, the fire makes an effort to escape in every direction; and, if it finds no natural vents, it forces a passage, by elevating and throwing off the incumbent earth. In this manner volcanoes commence, and their effects continue in proportion to the quantity of inflammable matter they contain. When the quantity of inflamed matter is inconsiderable, it produces only an earthquake, and exhibits no marks of a volcano. The air generated by subterraneous fire may also escape through small fissures; and, in this case, likewise, it will be attended with a succussion of the earth; but no volcano will appear. But, when the quantity of inflamed matter is great, and when it is confined on all sides by solid and compact bodies, an earthquake and a volcano are the necessary consequences. All these commotions, however, constitute only the first species of earthquakes, which are not felt but in the neighbourhood of the places where they happen. A violent eruption of Ætna, for example, will shake all the island of Sicily; but it will never extend to the distance of three or four hundred leagues. When Vesuvius bursts open a new mouth, it excites an earthquake in Naples and in the neighbourhood of the volcano; but these earthquakes never shake the Alps, nor do they extend to France or other countries distant from Vesuvius. Thus, earthquakes produced by volcanoes are limited to a small space; they are nothing but effects of the re-action of the fire, and they shake the earth in the same manner as the explosion of a powder-magazine occasions an agitation to the distance of several leagues.

But there is another species of earthquakes which are very different in their effects, and perhaps also in their cause. These earthquakes are felt at great distances, and shake a long tract of ground without the intervention either of a new volcano, or of eruptions in those which already exist. There are instances of earthquakes which have been felt at the same time in Britain, in France, in Germany, and in Hungary. These earthquakes always extend more in length than in breadth. They shake a zone or belt of earth with greater or less violence in different places; and they are generally accompanied with a hollow noise, like that of a heavy carriage rolling with rapidity.

As to the causes of this species of earthquake, it must be remarked, that the explosion of all inflammable substances, like that of gun-powder, generates a great quantity of air; that this air is highly rarefied by heat; and that its effects, from the compression it receives by being confined in the bowels of the earth, must be exceedingly violent. Let us suppose, that, at the depth of 100 or 200 fathoms, there are a vast collection of pyrites and sulphureous bodies, and that they are inflamed by the fermentation produced by the admission of water to them, or by other causes. What must be the effect? In the first place, these substances are not placed in horizontal beds, like the ancient strata, which were formed by the sediments of the waters. They are lodged, on the contrary, in the perpendicular fissures, in subterraneous caverns, and other places, to which the water has access. When inflamed, they generate a vast quantity of air, the spring of which, by being compressed within a small space, like that of a cavern, will not shake the earth immmediately above, but it will search for passages in order to expand and make its escape. Caverns and channels of subterraneous rivulets and springs, are the only natural passages for this rarefied air. Into these, therefore, it will rush with impetuosity, and produce in them a furious wind, the noise of which will be heard on the surface; and it will be attended with vibrations or succussions of the ground. This subterraneous wind produced by fire will extend the whole length of the caverns or channels, and occasion a shaking, more or less violent, in proportion to its distance from the heat, and to the width or narrowness of the canals. But this motion must necessarily run in a longitudinal direction; and the shaking, of course, must be felt over a long belt of ground. This air, however, cannot produce an eruption or a volcano; because it finds sufficient room for expanding itself, and diminishing its force; or rather, because it escapes through fissures in the form of vapour or of wind. But, although the existence of caverns or channels for the passage of this rarefied air should be denied, it is easy to conceive, that, in the very place where the explosion is made, as the earth is elevated to a considerable height, the neighbouring places must split horizontally in attempting to yield to the impulse communicated by the original motion; and, in this manner, passages may be gradually and successively opened, so as to communicate with very distant places. This explication corresponds with all the phænomena. Earthquakes are not felt at great distances at the same minute, or even the same hour. They are not accompanied with eruptions or external fire; and the noise almost constantly marks the progressive motion of the subterraneous wind. Other facts concur in establishing this theory. Blasts of wind, and vapours, sometimes of a suffocating nature, it is well known, arise from mines, independent of the motion of the air

produced by the current of water. It is equally well known, that winds issue from certain apertures of the earth, from caverns, abysses, and deep lakes, as Lake Boleslaw in Bohemia, which has been formerly mentioned.

When these remarks are considered, I cannot comprehend how the mountains should have originated from earthquakes, since the mineral and sulphureous bodies which occasion them are seldom to be met with but in the perpendicular fissures of mountains, and in other cavities of the earth, the greatest number of which have been produced by the operation of water; since these inflammable substances produce only a momentary explosion, and violent winds which follow the channels of subterraneous waters; since the duration of earthquakes on the surface of the earth is so short, they must be occasioned by a sudden explosion, and not by a continued conflagration; and, *lastly*, since those earthquakes, which extend over large tracts of ground, never produce the smallest eminence throughout their whole course.

Earthquakes, it is true, are more frequent in the neighbourhood of volcanoes, as in Sicily, and the environs of Vesuvius: but it appears, from repeated observations, that these earthquakes are very limited, and, consequently, can never form a chain of mountains.

It has sometimes been remarked, that the matters ejected from Ætna, after cooling for several years, and being afterwards moistened with rain, have rekindled, and thrown out flames with such violent explosions, as to occasion small earthquakes.

In 1669, during a violent eruption of Ætna, which began on the 11th of March, the summit of the mountain sunk considerably; which is a proof that this volcano proceeds rather from the superior part of the mountain than from the bottom of it. (See Phil. Trans. Abridg. vol. ii. p. 387.) Borelli, who is of the same opinion, observes, 'That the fire of a volcano, proceeds neither 'from the centre, nor from the bottom of a mountain, 'but from the top; and that the inflammation never 'kindles but at a small depth.' (Borelli de incendiis montis Ætnæ.)

Mount Vesuvius has frequently thrown out, during eruptions, great quantities of boiling water. Mr. Ray, who imagines that the fire of volcanoes comes from a very great depth, says, that this water proceeds from the sea, which communicates, by subterraneous passages, with the foot of the mountain. As a proof, he mentions the remarkable dryness of the top of Vesuvius, and the agitation of the sea during eruptions, which sometimes recedes so far as to leave the port of Naples entirely dry. But, supposing these facts to be true, they by no means prove that the fire of volcanoes proceeds from a great depth; for the water they eject is certainly rain-water, which penetrates through the fissures, and collects in the cavities of the mountain. Rills and springs issue from the tops of volcanoes, as well as from other high mountains; and, as the former are hollow, and have suffered more concussions than the latter, nothing can be more natural than they should collect water in their caverns, and that these waters should sometimes be ejected, along with other substances, in the time of eruptions. With regard to the motion of the sea, it arises solely from the shock communicated to the waters by the explosion, which makes them advance or retire according to different circumstances.

The most common substances thrown out by volcanoes, are torrents of melted minerals, which overflow the environs of the mountain. These rivers of lava extend to great distances; and, in cooling, they form beds, either horizontal or inclined, in the same manner as the strata accumulated by successive sediments from water. But the former are easily distinguishable from the latter: 1. Because strata of lava are not every where equal in thickness. 2. Because they contain nothing that has not evidently been calcined, vitrified, or melted. 3. Because their extent is more limited. As there is a vast number of volcanoes in Peru, and, as the bottoms of most of the Cordeliers are covered with substances which have been thrown out by eruptions, it is not surprizing that no sea-shells have been found there; for they must have been calcined and destroyed by the fire. But I am still persuaded, that, if the clay ground, which, according to M. Bourguet, is the ordinary earth in the valley of Quito, had been dug, shells would have been discovered there, as well as every where else, especially where the ground is not covered, like the bottoms of the mountains, with matters ejected from volcanoes.

It has often been asked, Why all volcanoes appear in high mountains only? I have partly solved this question in the preceding article. But, before finishing the present subject, I shall endeavour more fully to explain myself.

The peaks or points of mountains were originally covered with earth and sand, which, after being gradually washed down to the valleys by the rains, left nothing but those bare rocks or stones called the core of mountains, which, being likewise subjected to the action of the weather, small and large fragments of them must have been occasionally loosened, and, of course, must have rolled down to the plains. The rocks at the base of the summit being fully uncovered, and having lost their original support from the sand and earth, would necessarily give way a little, and, by separating from each other, would produce small intervals. But this yielding of the lower rocks could not take place without rending those which lay above them. In this manner the core of the mountain, from the summit to the base of the lower rocks would be split into an infinite number of perpendicular fissures of different dimensions. Through these the rains would penetrate and carry along with them, into the bowels of the mountain, all the minerals,

and other substances which they were capable of transporting or dissolving. Here pyrites, sulphur, and other combustible substances, would be produced; and, in the course of time, these bodies would accumulate in great quantities, and, by their fermentation, would give rise to explosions and other effects of volcanoes. Heaps of these mineral substances might likewise exist in the heart of the mountain, before the rain could penetrate so deep. In this case, as soon as the air or rain got access to them by means of the perpendicular fissures, a conflagration and volcano would instantly take place. No such phænomena can be exhibited in plains; for, as every thing there is at rest, and nothing can be displaced, it is not surprizing that the existence of volcanoes should be confined entirely to the mountains.

When coal-mines are opened, which are commonly found in clay-grounds, and at a great depth, the mineral substances above mentioned sometimes kindle into flames. There are examples in Scotland, Flanders, &c. of coal-mines which have continued to burn for many years. The admission of air is alone sufficient to produce this effect. But these inflammations occasion only slight explosions, and never form volcanoes; because, in such places, all being plain and solid, the fire cannot be excited to such a degree as in burning mountains, which are full of caverns and cliffs, through which the air penetrates, and augments the action of the fire so forcibly, as to give rise to the terrible effects we have been describing.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XVII.

Of new Islands, Caverns, perpendicular Fissures, &c.

NEW islands are produced either suddenly by the operation of subterraneous fires, or slowly by the accumulated sediments of water. Upon this subject we are furnished with indubitable facts, both by ancient historians, and by modern voyagers. Seneca tells us, that, in his time, the island of Therasia (now called Santorini,) suddenly emerged from the sea, to the astonishment of many spectators. Pliny relates, that 13 islands formerly arose all at once from the bottom of the Mediterranean, and that Rhodes and Delos are the chief of them. According to Ammianus Marcellinus, Philo, Pliny, &c. these 13 islands were not formed by an earthquake or by a subterraneous explosion, but were formerly concealed under the water, which sunk and uncovered them. Delos was even distinguished by the name of Pelagia, because it formerly belonged to the sea. Whether these 13 new islands were produced by the action of subterraneous fire, or by any other cause which diminished the quantity of water in the Mediterranean, it is not easy to determine. But we are informed by Pliny himself, that the island of Hiera, in the neighbourhood of Therasia, is composed of ferruginous masses, and of earth which had been thrown up from the bottom of the sea; and, in another place, he mentions several other islands which had been formed in the same manner. Upon this subject, however, we have facts more recent, and less involved in obscurity.

On the 23d of May, 1707, at sun-rising, there appeared, at the distance of two or three miles from the island of Therasia or Santorini, something which had the resemblance of a floating rock. Some men, stimulated by curiosity, approached it, and discovered that it had arisen from the bottom of the sea; that it increased under their feet; that oysters and other shells still adhered to the rocks; and that many pumice-stones lay on its surface. Two days before this rock appeared, there had been a slight earthquake in Santorini. This island continued to augment considerably, without any accident, till the 14th of June. It was then about half a mile in circumference, and 20 or 30 feet high, and the earth was white and mixed with clay. After this time, the sea began to be more and more agitated; vapours arose from it which infested the island of Santorini, and, on the 16th of July, 17 or 18 rocks rose all at once from the bottom of the sea, and united into one mass. These phænomena were attended with a frightful noise, which continued two months; and flames issued from the new island, which still augmented both in circumference and height; and the explosions were so violent, that they drove large stones to more than 7 miles distance. The island of Santorini itself was regarded by the ancients as a recent production; and, in 726, 1427, and 1573, it received considerable additions, beside the small islands formed in its neighbourhood. (See l'Hist. de l'Acad. des

Sciences, 1708, p. 23.) The same volcano, which, in the days of Seneca, raised the island of Santorini, produced, in Pliny's time, that of Hiera or Volcanella, and, in our days, the rock above described.

On the 10th of October, 1720, a great fire was seen to arise from the sea near the island of Tercera. Navigators being sent, by order of government, to examine it, they perceived, on the 19th of the same month, an island covered with fire and smoke; and a prodigious quantity of ashes was thrown to a great distance, as from a volcano, and accompanied with a noise similar to that of thunder. The earth was also perceived to shake in the neighbourhood; and a vast number of pumice-stones were found floating on the sea all round the new island. This last phænomenon has sometimes been remarked in the open sea. See Phil. Trans. abridg. vol. vi. part 2, p. 154.)

The historian of the French Academy, (ann. 1721, p. 26.) in relating this event, remarks, that, after an earthquake in the island of St. Michael, one of the Azores, there appeared a torrent of fire between this island and that of Tercera, which gave rise to two new rocks. And, in the subsequent year, the same historian gives the following detail.

'M. de l'Isle has informed the academy of several 'particulars concerning the new island among the 'Azores, which he received in a letter from M. de 'Montagnac, consul at Lisbon. On the 18th of September, 1721, M. de Montagnac's vessel was moored 'off the fortress of St. Michael; and he learned the 'following particulars from the pilot of the port.

'During the night of the 7th or 8th of December, '1720, there was a great earthquake in Tercera and St. 'Michael, which islands are distant from each other 'about 28 leagues, and a new island rose from the sea. 'It was, at the same time, remarked, that the point of 'the island of Peak, at the distance of 30 leagues, which 'formerly threw out flames, was extinguished. But a 'continual thick smoke issued from the new island, which 'was distinctly perceived by M. de Montagnac, as long 'as he continued in that part. The pilot assured him, 'that he had sailed round the island, and approached it 'as near as he could with safety. He sounded on the 'south side of it with a rope of 60 fathoms, but found 'no bottom. On the west side the water was much 'changed: it appeared to be mixed with white, blue, 'and green; and, at the distance of two miles, it seemed 'to be shallow and boiling. On the north-west, the 'side from which the smoke issued, he found, at 15 'fathoms, a bottom of coarse sand. He threw a stone 'into the sea, and, at the place where it fell, he observed 'the water boil, and mount into the air with great impetuosity. The bottom was so hot, that, at two different times, it melted a piece of suet which had been 'fastened to the end of the plumb line. The pilot likewise remarked, that smoke issued from a small lake, 'in the midst of a sandy plain. This island is nearly 'round, and high enough to be perceived, in clear weather, at the distance of seven or eight leagues.

'We have since learned, by a letter from M. Adrien, 'French consul at St. Michael, dated in March, 1722, 'that the new island is considerably diminished; that 'it is nearly on a level with the water; and that it will 'probably soon disappear.'

From these and many other facts of a similar nature, it is apparent, that inflammable bodies exist under the bottom of the sea, and that they sometimes produce violent explosions. The places where they happen may be considered as submarine volcanoes, which differ from common volcanoes only in the shorter duration of their effects; for, after the fire opens a passage to itself, the water rushes in, and extinguishes them. The elevation of new islands necessarily leaves caverns, which are soon filled by the waters; and the new ground, which consists of matter thrown out by the submarine volcano, must, in every respect, resemble that of Monti di Cinere, and other eminences which have been raised by terrestrial volcanoes. It is on account of the water's rushing into the voids and fissures produced by explosions, that submarine volcanoes exhibit their effects less frequently than common volcanoes, though both derive their origin from the same cause.

To subterraneous, or rather submarine fires, must be ascribed all those ebullitions of the sea, and water-spouts, which have been remarked in different places by mariners. They also produce storms and earthquakes, the effects of which are felt equally at sea as upon land. The islands raised by submarine volcanoes are generally composed of pumice-stones and calcined rocks.

Fire has frequently been observed to issue out of the waters of the sea. Pliny tells us, that the whole surface of the Thrasymen lake has appeared to be inflamed; and Agricola informs us, that, when a stone was thrown into the lake of Denstat in Thuringia, its descent was marked by a train of fire.

Lastly, The great quantities of pumice-stones discovered by voyagers in different parts of the ocean, as well as in the Mediterranean, evince the existence of volcanoes in the bottom of the sea, which differ not from those upon land, either in the violence of their explosions, or in the matter they throw out, but only in their rarity, and in the shortness of their duration. Hence it may be remarked, that the bottom of the sea every way resembles the surface of the earth, not admitting even the exception of volcanoes.

Between sea and land volcanoes there are many relations. Both of them exist on the tops of mountains. The Azore islands, and those of the Archipelago, are only the points of mountains, some of which are above,

and others under, the surface of the water. From the account of the new islands among the Azores, it appears, that the place where the smoke issued was only 15 fathoms deep, which, when compared with the ordinary depth of the ocean, demonstrates this place to be the top of a pretty high mountain. The same remark may be made with regard to the new island near Santorini. Its depth must have been inconsiderable, since oysters were found attached to the rocks which rose above the surface of the water. It likewise appears, that sea-volcanoes, as well as those upon land, have subterraneous communications; for, at the very time that the new island among the Azores arose, the summit of the volcano of St. George, in the island of Peak, sunk. It also merits observation, that new islands never appear but in the neighbourhood of old ones; and that there are no examples of new islands in the open seas. They ought, therefore, to be regarded as continuations of the ancient islands; and, when volcanoes happen to exist in the latter, it is not surprising that the former should contain the same materials, which may be kindled either by fermentation alone, or by the action of subterraneous winds.

Besides, new islands produced by earthquakes, or by subterraneous fires, are few in number. But the number of those formed by slime, sand, and earth, transported by rivers, or by the motions of the sea, is almost infinite. At the mouths of rivers, such quantities of earth and sand are amassed, as frequently give rise to islands of considerable extent. The sea, by retiring from certain coasts, leaves uncovered the highest parts of the bottom, and these parts constitute so many new islands. In the same manner, when the sea encroaches upon the land, it covers the plains, and the more elevated grounds appear in the form of islands. It is for this reason that there are few islands in the open seas, and that they are so numerous near the coasts.

Fire and water, though of very opposite natures, exhibit many effects so similar, that the one may often be mistaken for the other. Beside the productions peculiar to these elements, as crystal, glass, &c. they give rise to many great phænomena, which have such strong resemblances, that they can hardly be distinguished. Water, as we have seen, elevates mountains, and forms the greatest number of islands. Some mountains and islands likewise derive their origin from fire. The same observation is applicable to caverns, fissures, gulfs, &c. Some of them are the effects of fire, and others of water.

Caverns are, in a great measure, peculiar to mountains: they are seldom or never found in plains. They are frequent in the Archipelago, and other islands; because islands are generally nothing but the tops of mountains. Caverns, like precipices, are formed by the sinking or mouldering of rocks, or, like abysses, by the action of fire; for, to make a cavern form a precipice or an abyss, nothing farther is necessary than that the tops of the opposite rocks should come together and form an arch, which must frequently happen when they are loosened at the root, and shaken by earthquakes, or by the operation of time and of the weather. Caverns may be produced by the same causes which give rise to gulfs, apertures, or sinkings of the earth; and these causes are explosions of volcanoes, the action of subterraneous vapours, and earthquakes, which create such commo tions in the earth, as must necessarily produce caverns, fissures, and hollows of every kind.

The cavern of St. Patrick in Ireland is not so considerable as it is famous. The same remark may be made with regard to the Grotto del Cane in Italy, and to that of Mount Beni-guazeval, in the kingdom of Fez, which throws out fire. There is a very large cavern in the county of Derby in England. It is much larger than the celebrated cavern of Bauman, near the Black Forest of Brunswick. I was informed by the Earl of Morton, a philosopher more respectable for his merit than his high rank, that the entrance to this cavern, called the *Devil's Hole*, is larger than the door of any church; that a small river runs through it; that, after advancing some way, the vault of the cavern sinks down so low, that, in order to proceed farther, it is necessary to lie flat in a boat, and to be pushed through this narrow passage by people accustomed to the business; and that, after getting through, the roof, or arch of the cavern, rises to a great height; and, after walking a considerable way on the side of the river, the arch sinks again so low as to touch the surface of the water. Here the cavern terminates. The river, which seems to have its source in this part of the cavern, swells occasionally, and transports heaps of sand, which, by accumulating, forms a kind of blind alley, whose direction is different from that of the principal cavern.

In Carniola, near Potpechio, there is a large cavern, in which is a pretty considerable lake. Near Aldersperg, we meet with a cavern in which a man may travel two German miles. It contains several tremendous and deep precipices. (See Acta erud. Lips. anno 1689, p. 558.) The Mendip hills, in Somersetshire, likewise present us with extensive caverns, and very fine grottos. Near these caverns we find veins of lead, and sometimes large oak trees, buried 15 fathoms deep. In the county of Gloucester there is a large cavern called *Pen-park Hole*, at the bottom of which we meet with 32 fathoms of water. Here are also veins of lead.

It is apparent, that the Devil's Hole, and other caverns, from which large springs or brooks issue, have been gradually formed by the operation of the water, and their origin cannot be ascribed to earthquakes or volcanoes.

One of the largest and most singular caverns we are

acquainted with, is that of Antiparos, of which M. Tournefort has given a complete description. We first find a rustic cave about 30 feet wide, divided by some natural pillars. Between two pillars on the right, the ground slopes gently, and then more precipitately for about 20 paces to the bottom of the cavern. This is the passage to the grotto or interior cave, and is nothing but a dark hole, through which a man cannot pass without stooping, and the assistance of lights. We then descend, by means of a rope fixed at the entrance, a horrible precipice, and arrive on the borders of another still more tremendous, with corresponding abysses on the left. By a ladder placed on the margin of these gulfs, we get over a vast perpendicular rock. We then continue to slip through places less dangerous. But, when we think ourselves in the greatest safety, we are suddenly stopped by a frightful pass; to escape through which, we are obliged to glide on our backs along a large rock, and to descend by means of a ladder. When we arrive at the bottom of the ladder, we stumble for some time among irregular rocks, and then the famous grotto presents itself. This grotto is about 300 fathoms below the surface of the earth, and it appears to be about 40 fathoms high, and 50 wide. It is full of large and beautiful stalactites, which both depend from the roof of the vault and cover the floor. (See Tournefort's Voyage to the Levant.)

In that part of Greece called Achaia by the ancients, now Livadia, there is a large cavern in a mountain which was formerly famous for the oracles of Trophonius: it is situated between the Lake of Livadia and the sea, from which, at the nearest part, it is distant about four miles; and there are no less than 40 subterraneous passages through which the waters run under the mountain. (See Gordon's Geography, p. 179.)

In all countries which are subject to earthquakes or volcanoes, caverns are frequent. The structure of most of the islands of the Archipelago is exceedingly cavernous. The islands in the Indian Ocean, and particularly the Moluccas, appear to be chiefly supported upon vaults. The land of the Azores, of the Canaries, of the Cape de Verd Islands, and, in general, of almost all small islands, is in many places hollow and full of caverns; because these islands, as formerly remarked, are only the tops of mountains, which have suffered great convulsions either from volcanoes, or by the action of the waters, of frosts, and of other injuries of the weather. In the Cordeliers, where volcanoes and earthquakes are frequent, there are many caverns, precipices, and abysses.

The famous labyrinth in the island of Crete is not the work of nature alone. We are assured by M. Tournefort, that, in many parts of it, the operation of men is evident; and, it is probable, that this is not the only cavern which has been augmented by art. Mines and quarries are constantly digging; and, after these have been long deserted, it is not easy to determine whether such excavations have been the effects of nature or of art. Some quarries are amazingly extensive. That of Maestricht, for instance, is sufficient to shelter 50,000 men, and is supported by more than 1000 pillars of 20 feet high; and the earth and rock above is 25 fathoms thick. (See Phil. Trans. abridg. vol. ii. p. 463.) The salt mines of Poland exhibit excavations still more extensive. Near large cities, quarries and artificial hollows are common. But we must proceed no farther in detail. Besides, the operations of men, however great, will always make but an inconsiderable figure in the history of nature.

Volcanoes and water which form caverns in the bowels of the earth, produce likewise on its surface fissures, precipices, and abysses. At Cajeta in Italy, there is a mountain which had been formerly split by an earthquake in such a manner, that the separation seems to have been made by the hands of men. We have already mentioned the *Wheel-track*, or great fissure in the island of Machian, the abyss of Mount Ararat, the port or gap in the Cordeliers, that of Thermopylæ, &c. To these we might add the gap in the mountain of the Troglodites in Arabia, and that of the *Ladders* in Savoy, which was begun by nature, and finished by Victor-Amadæus. Considerable sinkings in the earth, the fall of rocks, and the subversion of mountains, are frequently produced by the waters, as well as by subterraneous fires. Of this many examples might be given.

'In the month of June, 1714, a part of the mountain 'of Diableret in Valois fell suddenly, and, in a few hours, 'the sky being serene, it appeared to have assumed a 'conical figure. It destroyed 55 houses, besides several 'men, and a great many cattle; and it covered a league 'square with its ruins. The sky was darkened with the 'dust: the collection of stones and earth which were 'amassed on the plain, exceeded 30 Rhenish perches in 'height, dammed up the waters, and gave rise to new 'lakes of considerable depths. But this phænomenon 'was not accompanied with the least vestige of bitumen, 'sulphur, or calcined lime-stone: nor, consequently, of 'subterraneous fire: the base of this great rock appeared 'to be rotten, and reduced to powder.' (Hist. de l'Acad. des Sciences, ann. 1715, p. 4.)

There is a remarkable example of these sinkings near Folkstone in the county of Kent. The hills in the neighbourhood sunk insensibly, without any earthquake or other commotion. The interior parts of these hills consist of rocks and chalk; and, by their sinking, they have pushed part of the adjacent land into the sea. A well attested relation of this fact may be seen in the Philosophical Transactions. (Abridg. vol. iv. p. 250.)

In 1618, the town of Pleurs was buried under the rocks at the foot of which it had been situated. In

1678, a great inundation was occasioned, in Gascony, by the sinking of some portions of one of the Pyrennees, which forced out the water that had been pent up in the subterraneous caverns of these mountains. In the year 1680, a still greater inundation was produced in Ireland, by the sinking of a mountain into caverns which had been full of water. It is not difficult to investigate the cause of these effects. It is well known, that subterraneous waters are every where frequent. These waters gradually work away sand and earth in their passages; and consequently they may, in the course of time, destroy the stratum of earth which serves as a basis to the mountain: if this stratum fail more on one side than on another, the mountain must, of necessity, be overturned; or, if the base wastes gradually and equally throughout, the mountain will sink, without being overturned.

Having mentioned a few of those convulsions and changes produced in the earth by what may be called the accidents of nature, we must not pass over in silence the perpendicular fissures in the different strata. These fissures are obvious, not only in all rocks and quarries, but in clays, and in every species of earth which has never been removed from its natural position. They are called perpendicular fissures; because, like the horizontal strata, they are never oblique, but from some accidental change. Woodward and Ray talk of fissures, but in a general and confused manner, and they never mention them under the appellation of perpendicular fissures, because they imagined that they might be indifferently either oblique or perpendicular. No author has hitherto attempted to explain their origin, though it is apparent, as remarked in a former article, that they have been occasioned by the drying of the materials which compose the horizontal strata. In whatever manner this drying should happen, perpendicular fissures must have been a necessary consequence; for the matter of the horizontal strata could not be diminished in size, without splitting, at different distances, in a direction perpendicular to the strata themselves. Under perpendicular fissures, I comprehend, not only the natural cracks in rocks, but all those separations which have been effected by convulsive accidents. When a mass of rock has suffered any considerable motion, the fissures are sometimes placed obliquely; but it is because the mass itself is oblique; and the smallest attention to quarries of marble and lime-stone, or to great chains of rocks, will convince us, that the general direction of fissures is perpendicular to the strata in which they are found.

The bowels of mountains are chiefly composed of parallel strata of stones and rocks. Between the parallel strata, we often meet with beds of matter softer than stone; and the perpendicular fissures are filled with sand, crystals, metals, &c. The formation of these last bodies is more recent than that of the horizontal strata in which sea-shells are found. The rains have gradually detached the sand and earth from the tops of mountains, and left the stones and rocks bare, which afford an opportunity of distinguishing with ease both the parallel strata and the perpendicular fissures. On the other hand, the rains and rivers have successively covered the plains with considerable quantities of earth, sand, gravel, and other bodies which are either soluble in or easily divisible by water. Of these have been formed beds of tufa, of soft stone, of sand, of rounded gravel, and of earth mixed with vegetable substances. But these beds contain no sea-shells, or, at most, but fragments of them, which have been detached from the mountains along with the earth and gravel. These recent beds should be carefully distinguished from the ancient and original strata, in which we almost universally find a greater number of entire shells placed in their natural situation.

In examining the internal order and distribution of the materials of a mountain, composed of common stone or calcinable lapidific matter, we generally find, after removing the vegetable soil, a bed of gravel, of the same nature and colour with the stones which predominate in the mountain; and, under the gravel, we meet with the solid rock. When the mountain is cut by a deep trench or *ravine*, the different banks or strata are easily distinguishable. Each horizontal stratum is separated by a kind of joint or suture, which is likewise horizontal. These strata generally augment in thickness, in proportion to their depth or distance from the top of the mountain; and they are all divided, vertically, by perpendicular fissures. In general, the first stratum under the gravel, and even the second, are not only thinner than those which form the base of the mountain, but so much cut by perpendicular fissures, that small portions of them only have any coherence. Most of these fissures, which exactly resemble the cracks in earth that has been dried, gradually disappear as they descend, and, at the base of the mountain, where they cut the larger strata in a more regular and more perpendicular manner than those near the surface, their number is much smaller.

These strata of rock often extend, without interruption, to great distances. Stones of the same species likewise are almost uniformly found in opposite mountains, whether they be separated by a narrow neck or a valley; and the strata never entirely disappear, unless when the mountain terminates in a large and level plain. Sometimes we find, between the vegetable soil and the gravel, a stratum of marl, which communicates its colour, and other qualities, to the neighbouring beds: the perpendicular fissures in the inferior rocks are, in this case, filled with marl, where it acquires a hardness equal, in appearance, to that of the surrounding stone; but, when exposed to the air, it splits, and becomes soft and ductile.

The beds of stone which compose the tops of moun-

tains are generally soft and tender, but those near the base are exceedingly hard. The first is commonly white, and of a grain so fine as to be hardly perceptible. In proportion as they descend, the rocks become more compact, and have a better grain; and the lowest beds are not only harder than the superior ones, but are also more compact and heavy. Their grain is fine and brilliant; and they are often so brittle as to break as purely and neatly as flint.

The heart of a mountain, then, is composed of different strata of stones, which are harder or softer in proportion to their distance from the summit; and they are broad at the base, and sharp and narrow at the top. The last is, indeed, a necessary result of the first: for, as the stones grow harder as they descend, it is natural to think, that the currents, and other motions of the water, which scooped out the valleys, and formed the contours of the mountains, must have gradually consumed, by their lateral friction, the materials of which the mountains are composed: and that this consumption would be proportioned to the hardness or softness of the matter acted upon. But, as the upper strata are known to be softest, and as their density increases according as they approach the base, the mountains must, of necessity, have assumed their present inclined, and somewhat conical figure. This is one great cause of the declivity of mountains; and it must always become more gentle, in proportion as the earth and gravel are brought down by the rain from their summits. For these reasons, the declivity of hills and mountains, composed of calcinable bodies, is less than that of those which consist of granite, or of flint in large masses. The latter generally rise almost perpendicularly to very great heights; because in these masses of vitrifiable matter, the superior, as well as the inferior strata, are extremely hard, and have presented nearly an equal resistance to the operation of the waters.

Though, in the tops of some hills which are flat, and pretty extensive, we find hard stone immediately under the vegetable soil; yet it should be remarked, that, in every example of this kind, what appears to be the summit of a hill is only a continuation of some more elevated hill in the neighbourhood, the upper strata of which consist of soft, and the inferior strata of hard stone; and the hard stone found on the top of the first hill is only a continuation of the under strata of the higher hill.

Still, however, on the tops of hills which are not surmounted by higher grounds, the stone is mostly of a soft and friable nature; and hard stone cannot be had without digging to a considerable depth. It is between these layers of hard stone only that marble is to be found; and it is variegated with different colours by metallic substances carried down by rain-water, and filtrated through the strata: and it is probable that, in every country which furnishes stones, marble would be found, if pits were dug to a sufficient depth. *Quoto enim*, says Pliny, *loco non suum marmor invenitur?* It is, in fact, a more common stone than is generally imagined, and differs from other stones only in the fineness of its grain, which renders it compact, and susceptible of a fine and brilliant polish.

Both the perpendicular fissures, and the horizontal joints of quarries, are often filled, or encrusted, with concretions, which are sometimes transparent, and of regular figures, as crystals, and sometimes earthy and opaque. Water runs through the perpendicular fissures, and even penetrates the close texture of the stone itself. Stones which are porous imbibe water so copiously, that frost splits them in pieces. The rain-waters, by filtrating through different strata, are impregnated with a great variety of substances. They first sink through the perpendicular fissures; they then penetrate the strata of stone, and deposit in the horizontal joints, as well as in the perpendicular fissures, such matter as they collect in their course, and give rise to different concretions, according to the nature of these substances. For example, when the water filtrates through marl, clay, or soft stone, the matter which it deposits is nothing but a fine pure marl, and commonly appears in the perpendicular fissures under the form of a porous, soft, white, light substance, known among naturalists under the name of *Lac Lunæ*, or *Medulla Saxi*.

When veins of water, charged with stony matter, run along the horizontal joints of soft stone or chalk, this matter adheres to the surface of the stones, and forms a white, scaly, light, and spongy crust, which, from its resemblance to the agaric, has been called *mineral agaric*. But, if the strata through which the water penetrates be hard stone, the filter being closer, the water it allows to pass will be impregnated with a stony matter more pure and homogeneous; and, consequently, the particles being capable of a more compact and intimate union, will form concretions, nearly of equal density with the stone itself, and somewhat transparent. In quarries of this kind, the surface of the stones are encrusted with undulated concretions, which entirely fill up the horizontal joints.

In grottos and cavities of rocks, which may be regarded as the basins or common sewers of the perpendicular fissures, the different directions of the veins of water give different forms to the concretions that result from them. These forms are generally wreathed, or resemble an inverted cone, attached to the roof of the cavern; or, rather, they are white, hollow cylinders, composed of concentric coats. The impregnated waters sometimes fall in drops upon the floor of the cavern, and form columns, and a thousand whimsical figures, to which naturalists have given the different appellations of *stalactites, stelegmites, osteocollæ*, &c.

Lastly, when the concreting juices issue immediately

from marble, or very hard stone, the lapidific matter is rather dissolved than suspended in the water, and it forms a kind of columns with triangular points, which are transparent, and consist of oblique coats. This substance is distinguished by the name of *spar* or *spalt*. It is transparent and colourless, except when the stone or marble through which it filtrates contains metallic particles. This spar is of equal hardness with the stone itself, and it dissolves in acids, and calcines with the same degree of heat. Hence it is evident, that spar is a true stone, and perfectly homogeneous. It may even be considered as a pure and elementary stone.

Most naturalists, however, consider this as a distinct substance, existing independent of stone. It is the lapidific or crystalline juice, which, in their estimation, not only cements the particles of common stone, but even those of flint. This juice, they alledge, daily augments the density of stones by reiterated filtrations, and at last converts them into flint. When concreted into spar, it perpetually receives fresh supplies of still purer juice, which increases both its hardness and its density, till it changes to the consistence of glass, then to that of crystal, and at last it is converted into genuine diamond.

But, on this supposition, why does the lapidific juice produce stone in some provinces only, and nothing but flint in others? It may be said, that the one province is less ancient than the other, and that the juice has not had time sufficient to complete its natural operations. But in this there is not the shadow of probability. Besides, from whence does this juice proceed? If it gives rise to stones and flints, from whence does it derive its own origin? It is obvious that it has no existence independent of those substances which alone can impart to the water that penetrates them a petrifying quality that uniformly corresponds with their nature and peculiar properties. Thus, when it filtrates through stone, it produces spar; when it issues from flint it forms crystal; and there are as many species of this juice as of bodies from which it proceeds. Experience confirms this account of the matter. The waters which filtrate through quarries of common stone form tender and calcinable concretions similar to the stones themselves. On the other hand, the waters which exude from granite or from flint, produce concretions hard and vitrifiable, and they have all the other properties of flint, as the former had all those of stone. In the same manner, the waters which filtrate through mineral aud metallic substances, give rise to pyrites, marcasites, and metallic grains.

It was formerly remarked, that all matter might be divided into two great classes of Vitrifiable and Calcinable. Clay and flint, marl and stone, may be regarded as the two extremes of each class, the intervals between which are filled with an almost infinite variety of mixts, that have always one or other of these substances for their basis.

The substances belonging to the first class can never acquire the properties of those of the latter. Stone, however ancient, will for ever be equally removed from the nature of flint, as clay is from that of marl. No known agent can ever force them from the circle of combinations peculiar to their nature. Places which produce marble and stone will always continue to do so, as infallibly as those that produce only sand-stone, flint, and granite, will never produce lime-stone or marble.

If we examine the order and distribution of the materials of a hill composed of vitrifiable substances, we shall generally find, under the vegetable soil a stratum of clay, which is likewise a vitrifiable substance analogous to flint, and which, as already remarked, is only a decomposition of vitrifiable sand; or rather, we shall find, under the soil, a stratum of vitrifiable sand. This stratum of clay or of sand corresponds with the bed of gravel in hills consisting of calcinable matters. Below the stratum of clay or of sand, we meet with some beds of free-stone, which seldom exceed half a foot in thickness, and they are divided into small portions by perpendicular fissures. Under these are several strata of the same matter, and likewise beds of vitrifiable sand. In proportion as we descend, the free-stone is more dense, and its thickness increases. Below these, we find what I call *live-rock*, or *flint in large masses*, a substance so hard as to resist the file, and all kinds of acids, more powerfully than vitrifiable sand or powder of glass, upon which aqua-fortis seems to have some effect. When struck with another hard body, it throws out sparks of fire, and exhales a penetrating sulphureous vapour. This flinty substance is commonly found along with beds of clay, of slate, of pit-coal, of vitrifiable sand: and it corresponds to the strata of hard stone and marble, which serve as the basis of hills that consist of calcinable matter.

The waters, in passing through the perpendicular fissures, and in penetrating the strata of vitrifiable sand, of free-stone, of clay, and of slate, are impregnated with the finest and most homogeneous particles of these substances, and produce various concretions, such as talc, asbeftos, and other bodies which owe their existence to distillation through vitrifiable matter.

Flint, notwithstanding its hardness and density, has, like marble and common stone, its exudations, from which result stalactites of different species, varying in transparency, colour and configuration, according to the nature of the flint that produces them, and to the different metallic or heterogeneous particles it contains. Rock-crystal, all the precious stones, and even the diamond itself, may be regarded as stalactites of this kind. The flints in small masses, the strata or coats of which

are generally concentric, are only stalactites or parasitical stones from the flints in large masses; and most of the fine opaque stones are nothing but species of flint. The substances produced by the vitrifiable class of bodies are not, as we have seen, so various as the concretions formed by those of the calcinable. Most of the concretions formed by flint are hard and precious stones; but those produced by calcareous stones are friable, and of no value.

Perpendicular fissures are found in flint-rocks as well as in stone. They are even frequently larger in flint, which proves this substance to be drier than stone. Both the hill consisting of calcinable, and that composed of vitrifiable matter, have clay or vitrifiable sand for their bases, which are the most commonly diffused matters of the globe, and which I regard as the lightest, being the scoriæ of the vitrified matter that constitutes the interior parts of the earth. Thus all mountains as well as plains are founded either on clay or sand. We have seen, for example, in the pits of Amsterdam, and in that of Marly-la-ville, that vitrifiable sand was always the deepest stratum.

It may be observed, in most bare rocks, that the walls of perpendicular fissures, whether they be narrow or wide, correspond as exactly with each other as split pieces of wood. In the large quarries of Arabia, which consist mostly of granite, the perpendicular fissures are frequent; and, though some of them are 20 or 30 yards wide, the sides correspond exactly, and leave a deep cavity between them. (See Shaw's Travels.) It is likewise common to find, in perpendicular fissures, shells divided into two pieces, each piece remaining attached to the opposite sides of the fissure; which proves, that these shells were deposited in the solid stratum before it was split. (See Woodward, p. 298.)

In some quarries mentioned by Mr. Shaw, the perpendicular fissures are exceedingly large; and for this reason, perhaps, they are less numerous. In quarries of granite and flint in large masses, blocks of stone may be raised, as the obelisks and columns at Rome of 60, 80, 100, and 150 feet long, without the least interruption. It appears, that these vast blocks have been raised from the same quarry, and, like some species of free-stone, that they may be had of any given thickness. In other substances, the perpendicular fissures are very narrow, as in clay, in marl, and in chalk; and they are wider in marble and hard stone. Some are imperceptible, because they have been filled with a matter nearly similar to that of the stone itself; but still they interrupt the continuity of the stones, and are called *hairs* by the workmen. I have often remarked, that these hairs in marble and stone differed from perpendicular fissures only in the separation of parts not being complete. These species of fissures are filled with a transparent matter, which is a true spar. In quarries of free-stone, the fissures are numerous, and considerably large, because rocks of this kind have often a less solid base than that which supports marble or lime-stone, the former generally resting upon a fine sand, and the latter upon clay. In many places, free-stone is not to be found in large masses; and in most quarries, where this stone is good, the blocks lie irregularly upon one another, in the form of cubes or parallelopipeds, as in the hills of Fountainbleau, which appear, at a distance, like the ruins of old buildings. This irregular disposition has been occasioned by the sandy foundation of these hills allowing the blocks to sink and tumble upon each other, especially where quarries have been formerly wrought, which has given rise to a great variety of fissures and intervals between the different blocks: and it may be remarked, in all countries abounding with sand and free-stone, that there are many fragments of rocks and large stones in the middle of the plains and valleys; and that, on the contrary, in countries abounding with marble and hard stone, these scattered fragments, which have rolled down from the hills, are exceedingly rare. This phænomenon is owing to the different solidities of the bases upon which these stones are supported, and to the extent of the banks of marble or lime-stone, which is always more considerable than that of free-stone.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XVIII.

Of the Effects of Rains—Of Marshes, Subterraneous Wood and Waters.

IT has already been remarked, that rains, and the currents of water which they produce, continually detach, from the summits and sides of mountains, earth, gravel, &c. and carry them down to the plains; and that the rivers transport part of them to the sea. The plains, therefore, by fresh accumulations of matter, are perpetually rising higher; and the mountains, for the same reason, are constantly diminishing both in size and elevation. Of the sinking of mountains, Joseph Blancanus relates several facts which were publicly known in his time. The steeple of the village of Craich, in the county of Derby, was not visible in 1572, from a certain mountain, on account of a higher mountain which intervened; but, 80 or 100 years afterwards, not only the steeple, but likewise part of the church, were visible from the same station. Dr. Plot gives a similar example of a mountain between Sibbertoft and Ashby, in the county of Northampton. Sand, earth, gravel, and small stones, are not only carried down by the rains, but they sometimes undermine and drive before them large rocks, which considerably diminish the height of mountains. In general, the rocks are pointed and perpendicular in proportion to the height and steepness of mountains. The rocks in high mountains are very straight and naked. The large fragments which appear in the valleys have been detached by the operation of water and of frosts. Thus sand and earth are not the only substances detached from mountains by the rains; they attack the hardest rocks, and carry down large fragments of them into the plains. At Nant-phrancon, in 1685, a part of a large rock, which was supported on a narrow base, being undermined by the waters, fell and split into a number of fragments, the largest of which made deep trenches in the plain, crossed a small river, and stopped on the other side. To similar accidents we must ascribe the origin of all those large stones which are found in valleys adjacent to mountains. This phænomenon, as formerly remarked, is more common in countries where the mountains are composed of sand and free-stone, than in those the mountains of which consist of clay and marble; because sand is a less solid basis than clay.

To give an idea of the quantity of earth detached from mountains by the rains, we shall quote a passage on this subject from Dr. Plot's Natural History of Stafford. He remarks, that a great number of coins struck in the reign of Edward IV. i. e. 200 years ago, were found buried 18 feet below the surface: hence, he concludes, that the earth, which is marshy where the coins were found, augments about a foot in eleven years, or an inch and a twelfth each year. A similar observation may be made on trees buried 17 feet below the surface, under which were found medals of Julius Cæsar. Thus, the soil of the plains is considerably augmented and elevated by the matters washed down from the mountains.

The sand, gravel, and earth carried down from the mountains into the plains, form beds which ought not to be confounded with the original strata of the globe. To the former belong the beds of tufa, of soft stone, and of sand and gravel, which have been rounded by the operation of water. To these may be added those beds of stone which have been formed by a species of incrustation, none of which derive their origin from the motion or sediments of the sea. In these strata of tufa and of soft imperfect stones, we find a number of different vegetables, leaves of trees, land or river-shells, and small terrestrial animals, but never sea-shells, or other productions of the ocean. This circumstance, joined to their want of solidity, evidently proves, that these strata have been superinduced upon the dry surface of the earth, and that they are more recent than those of marble and other stones which contain sea-shells, and have been originally formed by the waters of the sea. Tufa, and other new stones, appear to be hard and solid when first dug out of the earth; but they soon dissolve after being exposed to the operation of the weather. Their substance is so different from that of true stone, that, when broken down in order to make sand of them, they change into a kind of dirty earth. The stalactites, and other stony concretions which M. Tournefort apprehended to be marbles that had vegetated, are not genuine stones. We have already shown, that the formation of tufa is not ancient; and that it is not entitled to be ranked with stones. Tufa is an imperfect substance, differing from stone or earth, but deriving its origin from both by the intervention of rain water, in the same manner as incrustations are formed by the waters of

certain springs. Thus, the strata of these substances are not ancient; nor have they, like the other species, been formed by sediments from the waters of the ocean. The strata of turf are also recent, and have been produced by successive accumulations of half corrupted trees and other vegetables, which owe their preservation to a bituminous earth. No production of the sea ever appears in any of these new strata. But, on the contrary, we find in them many vegetables, the bones of land animals, and land and river-shells. In the meadows near Ashly, in the county of Northampton, for example, they find, several feet below the surface, snail-shells, plants, herbs, and several species of river-shells, well preserved; but not a single sea-shell appears. (See Phil. Trans. abridg. vol. iv. p. 271.) All these new strata have been formed by the waters on the surface changing their channels, and diffusing themselves on all sides. Part of these waters penetrate the earth, and run along the fissures of rocks and stones. The reason why water is so seldom found in high countries, or on the tops of hills, is, because high grounds are generally composed of stones and rocks. To find water, therefore, we must cut through the rocks till we arrive at clay or firm earth. But, when the thickness of the rock is great, as in high mountains where the rocks are often 1000 feet high, it is impossible to pierce them to their base; and consequently it is impossible to find water in such situations. There are even extensive countries that afford no water, as in Arabia Petræa, which is a desert where no rains fall, where the surface of the earth is covered with burning sands, where there is hardly the appearance of any soil, and where nothing but a few sickly plants are produced. In this miserable country, wells are so rare, that travellers enumerate only five between Cairo and Mount Sinai, and the water they contain is bitter and saltish.

When the superficial waters can find no outlets or channels, they form marshes and fens. The most celebrated fens in Europe are those of Russia at the source of the Tanais; and those of Savolaxia and Enasak in Finland: there are also considerable marshes in Holland, Westphalia, and other countries. In Asia are the marshes of the Euphrates, of Tartary, and of the Palus Meotis. However, marshes are less frequent in Asia and Africa than in Europe. But the whole plains of America may be regarded as one continued marsh; which is a greater proof of the modernness of this country, and of the scarcity of its inhabitants, than of their want of industry.

There are extensive fens in England, particularly in Lincolnshire, near the sea, which has lost a great quantity of land on one side, and gained as much on the other. In the ancient soil many trees are found buried under the new earth which has been transported and deposited by the water: the same phænomenon is common in the marshes of Scotland. Near Bruges in Flanders, in digging to the depth of 40 or 50 feet, a vast number of trees were found, as close to each other as they are in a forest. Their trunks, branches, and leaves were so well preserved, that their different species could be easily distinguished. About 500 years ago, the earth where these trees were found was covered with the sea; and, before this time, we have neither record nor tradition of its existence. It must, however, have been dry land, when the trees grew upon it. Thus the land that, in some remote period, was firm, and covered with wood, has been overwhelmed with the waters of the sea, which, in the course of time, have deposited 40 or 50 feet of earth upon the ancient surface, and then retired. A number of subterraneous trees was likewise discovered at Youle in Yorkshire, near the river Humber. Some of them are so large as to be of use in building; and it is affirmed, that they are as durable as oak. The country people cut them into long thin slices, and sell them in the neighbouring villages, where the inhabitants employ them for lighting their pipes. All these trees appear to be broken; and the trunks are separated from the roots, as if they had been thrown down by a hurricane or an inundation. The wood appears to be fir; it has the same smell when burnt, and makes the same kind of charcoal. (See Phil. Trans. No. 228.) In the Isle of Man, there is a marsh called *Curragh*, about six miles long and three broad, where subterraneous fir-trees are found; and, though 18 or 20 feet below the surface, they stand firm on their roots. (See Ray's Discourses, p. 232.) These trees are common in the marshes and bogs of Somerset, Chester, Lancashire, and Stafford. In some places there are subterraneous trees which have been cut, sawed, and squared by the hands of men; and even axes, and other implements, are often found near them. Between Birmingham and Bromley, in the county of Lincoln, there are hills of a fine light sand, which is blown about by the winds, and transported by the rains, leaving bare the roots of large firs, in which the impressions of the axe are still exceedingly apparent. These hills have unquestionably been formed, like downs, by successive accumulations of sand transported by the motions of the sea. Subterraneous trees are also frequent in the marshes of Holland, Frizeland, and near Groningen, which abound in turfs.

Subterraneous trees are of different species, viz. firs, oaks, birch, beech, yew, hawthorn, willow, ash, &c. In the fens of Lincoln, along the river Ouse, and on Hatfield Chace in Yorkshire, these trees stand erect, as if they were growing in a forest. The oaks are extremely hard, and are used in building, where they are said to last long, which I think improbable, as all the specimens I have examined lose their solidity, after being dried and exposed to the air. The ashes are tender, and soon fall into dust. Some of these trees are evidently cut and

sawed with instruments; and the hatchets, which are sometimes found along with them, resemble the knives formerly used in sacrifices. Beside trees, we also meet with vast quantities of filberds, acorns, and fir-cones, in many other fens in England, Scotland, and Ireland, as well as in the marshes of France, Switzerland, Savoy, and Italy. (See Phil. Trans. abridg. vol. iv. p. 218, &c.)

For four miles round the town of Modena, whenever the earth is dug to the depth of 63 feet, the workmen pierce about five feet more with a boring instrument, through which the water rushes up with such impetuosity, that it fills the wells to the top, almost instantaneously. The water in these wells continues perpetually, and is neither augmented nor diminished by rains or drought. What is still more remarkable in this spot, whenever the workmen dig to the depth of 14 feet, they find the rubbish and ruins of an ancient city, paved streets, houses, and different pieces of Mosaic work. Below this the earth is solid, and appears not to have been moved. Still lower, however, we find a moist soil mixed with vegetables; and, at the depth of 26 feet. entire trees, as filberds, with nuts upon them, and great quantities of branches and leaves. At 28 feet, there is a stratum of soft chalk, 11 feet thick, mixed with sea-shells; and after this we still meet with vegetables, leaves, and branches of trees, till we arrive at the depth of 63 feet, where there is a stratum of sand mixed with gravel and shells, similar to those which appear on the coasts of Italy. These successive strata lie always in the same order, wherever pits have been dug; and sometimes the boring instrument falls in with the trunks of large trees, which the workmen pierce with great labour. They likewise meet with bones of animals, pit-coal, flints, and pieces of iron. Ramazzini, who relates these facts, thinks, that the gulf of Venice formerly extended beyond Modena, and that this land, in the progress of time, has been gradually formed by the rivers, assisted, perhaps, by inundations of the sea.

I will insist no longer upon the varieties in the composition of new strata. It is sufficient to have shown that they have been produced by no other cause than the waters which run or are stagnant upon the surface, and that they are neither so hard nor so solid as the ancient strata which were formed under the waters of the ocean.

PROOFS OF THE THEORY OF THE EARTH.

ARTICLE XIX.

Of the Changes of Land into Sea, and of Sea into Land.

FROM what has been remarked in article I. VII. VIII. and IX. it is apparent, that the terrestrial globe has undergone some great and general changes; and it is equally certain, from what has been delivered in the other articles, that the surface of the earth has suffered particular alterations. Though we are not sufficiently acquainted with the order or succession of these particular changes, we know the principal causes by which they were produced. We can even distinguish their different effects; and, if we were able to collect all the facts which natural and civil history afford concerning the revolutions that have happened on the surface of the earth, our theory would unquestionably receive additional supports, and would be rendered still more satisfactory.

One of the principal causes of these revolutions is the motion of the sea, which has continued invariably the same in all ages; for, as the sun, the moon, the earth, the waters, the air &c. have existed from the moment of creation, the effects of the tides, of the motion of the sea from east to west, of the currents, and of the winds, must have been felt for an equal time: and, even supposing the axis of the globe to have formerly had a different inclination, and that the continents, as well as the seas, were differently disposed, the motions of the ocean, and the causes and effects of the winds, would have remained unaltered. In whatever part of the globe the immense quantities of water which fill the ocean, were collected, they would be subjected to the same motions.

It was no sooner suspected that our continent might formerly have been the bottom of the sea, than the fact became incontestible. The spoils of the ocean found in every place, the horizontal position of the strata, and the corresponding angles of the hills and mountains, appeared to be convincing proofs; for, when we examine the plains, the valleys, and the hills, it is apparent, that the surface of the earth has been figured by the waters. When we descend into the bowels of the earth, it is

equally evident, that those stones which include sea-shells, have been formed by sediments deposited by the waters, since the sea-shells themselves are impregnated with the same matter that surrounds them. And, in fine, if we consider the corresponding angles of the hills and mountains, we cannot hesitate in pronouncing, that they received their configuration and direction from currents of the ocean. It is true, that since the earth was first left uncovered with water, the original figure of its surface has been gradually changing. The mountains have diminished in height; the plains have been elevated; the angles of the hills have become more obtuse; those bodies which have been rolled along by the rivers have received a roundish figure; new beds of tufa, of soft stone, of gravel, &c. have been formed. But every thing has remained essentially the same. The ancient form is still recognisable; and I am persuaded, that every man may be convinced, by his own eyes, of the truth of all that has been advanced on this subject; and, that whoever has attended to the proofs I have given, must be fully satisfied, that the earth was formerly under the waters of the ocean, and that the surface which we now behold received its configuration from the currents and movements of the sea.

We formerly remarked, that the principal motion of the sea is from east to west. The ocean, accordingly, seems to have gained from the eastern coasts both of the Old and the New Continent, a space of no less than 500 leagues. For the proofs we must refer to Art. IX. and shall here only add, that the direction of all straits which join two seas, is from east to west. The straits of Magellan, of Frobisher, of Hudson, of Ceylon, of the Sea of Corea, and of Kamtschatka, lie all in this direction, and appear to have been formed by the irruption of the waters, which, being forcibly pushed from east to west, have opened these passages, where the waters still preserve a stronger current in this than in any other direction; for, in all straits of this kind, the tides are high and violent; but, in those situated on the western coasts, as that of Gibraltar, of Sunda, &c. the motion of the tides is almost imperceptible.

The inequalities at the bottom of the sea change the direction of the motion of the waters. These inequalities have originated from sediments and matters transported by the tides, or by other movements in the water. The tides are the principal and first, though not the only cause, which produced these inequalities. The wind is another cause; though its action begins at the surface, it agitates the whole mass to the greatest depths, as appears from particular bodies which are detached from the bottom of the sea, and thrown ashore during violent storms only.

It has already been mentioned, that, between the tropics, and even some degrees beyond them, an east wind perpetually blows. This wind, which assists the general motion of the sea from east to west, is as ancient as the tides; because it is occasioned by the rarefaction of the air produced by the heat of the sun. There are two combined causes, therefore, the operation of which is greatest in the equatorial regions: 1st, The tides, which are greatest in the southern latitudes; and 2d, The east winds, which constantly reign in these climates. These two causes have concurred, from the first formation of the earth, in producing a motion in the waters from east to west, and in agitating them more violently in this region of the globe than in any other. It is for this reason that we find between the tropics the greatest inequalities upon the surface of the earth. That part of Africa which lies between these circles, is nothing but a group of different chains of mountains, which generally extend from east to west, as appears from the direction of the great rivers that traverse this unknown region. The same observation holds with regard to the countries both of Asia and America, which lie between the tropics.

The general motion of the sea from east to west, combined with the tides, currents, and winds, produce a variety of effects, both on the bottom of the ocean, and on the coasts. Varenius thinks it extremely probable, that gulfs and straits have been formed by reiterated efforts of the ocean against the land; that the gulfs of Arabia, of Bengal, and of Cambaya, have been produced by irruptions of the waters, as well as the straits between Sicily and Italy, between Ceylon and India, between Greece and Eubœa, &c.; that the probability of such irruptions, and of certain lands having been deserted by the sea, is strengthened by the scarcity of islands in the middle of great seas, and by their never appearing there in groups; that, in the immense space occupied by the Pacific Ocean, there are only two or three small islands near the centre of it; and that, in the vast Atlantic Ocean between Africa and Brazil, we find only the small islands of St. Helena and Ascension. But all islands lie near large continents, as those of the Archipelago, which approach the continents both of Europe and Asia; the Canaries are near Africa; the Indian islands lie near the eastern part of the continent of Asia; the Antilles lie off the coast of America; and the Azores alone lie at a considerable distance both from Africa and America.

The popular tradition among the inhabitants of Ceylon, that their island had been separated from the peninsula of India by an irruption of the sea, is extremely probable. The great number of rocks and shoals between the island of Sumatra and the continent demonstrate their former union. The Malabarians affirm, that the Maldiva islands once made a part of the continent of India; and, in general, we may believe, without

hesitation, that all the eastern islands have been separated from continents by irruptions of the ocean. (See Varen. Geog. p. 203, 217, and 220.)

The island of Great Britain appears to have been formerly a part of the continent; and that England was once joined to France, the narrowness of the strait, and the sameness of the strata of stone and of earth on the opposite sides, are a sufficient indication. If we suppose, says Dr. Wallis, that France was connected to England by an isthmus between Calais and Dover, two tides would necessarily strike with violence against each side of it twice every twenty-fours; and the operation of the sea, both on the east and west of this isthmus, would, in the course of time, gradually cut through such a narrow neck of land. The tides acting with violence not only against this isthmus, but also against the coasts of France and of England, must have carried away vast quantities of earth, sand, and clay, from every part on which the waves exerted their fury. Their course, however, being interrupted by the isthmus, they would not, as might be imagined, deposite their sediments upon its shores, but would transport and deposite them on the great plain which now forms the marsh of Romney, and is four miles broad and eight long; for no man, who has ever seen this plain, can possibly doubt of its having been formerly covered with the sea, as, without the intervention of the dikes of Dimchurch, a great part of it would still be overflowed by the spring-tides.

The German sea would act in the same manner against this isthmus and against the coasts of England and Flanders, and would carry its sediments into Holland and Zealand, the soil of which was formerly under the waters, though it is now elevated 40 feet above them. On the English coast, the German sea must have occupied that large valley which commences at Sandwich, runs by Canterbury, Chatham, Chilham, and terminates at Ashford, a space of more than 20 miles. Here the land is much more elevated than it was in ancient times; for, at Chatham, the bones of an hippopotamos were found buried at the depth of 17 feet, and likewise anchors of ships, and sea-shells.

Nothing is more apparent than that new lands are formed by the earth, sand, clay, &c. transported and deposited by the sea: for, in the island of Okney, which is adjacent to the marshy coast of Romney, there was a flat space of ground in continual danger of being overflowed by the river Rother; but this flat, in less than 60 years, has been considerably elevated by the accession of fresh matter brought in by every tide. This river has, besides, deepened its channel so much, that its mouth, which, less than 50 years ago, was fordable by men, is now capable of receiving large vessels.

In the same manner has the bank of sand, which runs obliquely from the coast of Norfolk to that of Zealand, been formed. This bank is the place where the German and French seas encounter since the rupture of the isthmus; and it is here that the waters deposit the earth and sand which they carry off from the coasts. It is even probable that this bank of sand may, in a succession of ages, give rise to a new isthmus. (See Phil. Trans. abridg. vol. iv. p. 227.)

It is extremely probable, says Mr. Ray, that the island of Great Britain was formerly joined to France: whether it was separated by an earthquake, by an irruption of the ocean, or by the operation of men, we know not. But the former junction of Britain to the continent is apparent from the identity of the rocks and different strata, at the same elevation, on the opposite coasts; and from the similar extent of the rocks on each side, being both about six miles. The narrowness of this strait, which exceeds not 24 English miles, and its shallowness, when compared to the depth of the neighbouring sea, render it probable that England has been separated from France by some accident. To these proofs we might add, that wolves and bears formerly existed in this island: it is not probable that these animals could swim over, nor that such destructive creatures would be transported by men; for, in general, the noxious animals of the continent are found in all those islands which are very near it, but never in those that are remote. This fact was remarked by the Spaniards when they arrived at America. (See Ray's Discourses, p. 208.)

In the reign of Henry I. of England, a part of Flanders was overflowed by an irruption of the sea. In 1446, more than 10,000 persons were drowned by a similar irruption in the territory of Dordrecht, and more than 100,000 round Dullart in Frizeland and Zealand. In these two provinces, above 300 villages were overflowed. The tops of their towers and spires are still visible above the surface of the water.

From the coasts of France, England, Holland, and Germany, the sea has in many places retreated. Hubert Thomas, in his description of the country of Liege, assures us, that the walls of the city of Tongres, were formerly surrounded by the sea, though it is now 35 leagues distant from that city. He gives several satisfactory reasons: among others, he informs us, that, in his time, the iron rings, to which ships were fastened, still remained in the walls. The fens of Lincoln, of the island of Ely, and the Crau of Provence in France, may be regarded as lands abandoned by the sea, which has likewise, since 1665, retired considerably from the mouth of the Rhone. At the mouth of the Arno in Italy, a large quantity of land has been gained from the sea; and Ravenna, which was formerly a harbour, is no longer a sea-port. The whole of Holland appears to be new land: the surface of the ground is nearly on a level with the sea, although it has received daily elevations from the mud and earths transported by the Rhine, the Maese, &c.; for the soil of Holland was formerly, in many

places, computed to be 50 feet below the level of the sea.

It has been alledged, that, in 860, a furious tempest drove such quantities of sand upon the coast, that the mouth of the Rhine near Catt was entirely blocked up; and that this river overflowed the whole country, overturned trees and houses, and at last emptied itself into the channel of the Maese. In 1421, another inundation separated the city of Dordrecht from the main land, overwhelmed 72 villages, and drowned 100,000 persons, besides a vast number of cattle. The dike of Issel was broken down in 1638, by the ice-boards from the Rhine blocking up the passage of the water, which occasioned an opening in the dike of several fathoms, and a great part of the province was laid under water before the breach could be repaired. The province of Zeland, in 1682, suffered a similar inundation, which drowned more than 30 villages; and an amazing number of men and cattle perished, as the unfortunate event happened during the night. The loss would have been still greater, had not a south-east wind opposed the motion of the waves; for there was such a swell in the sea, that the water rose 18 feet above the highest ground in the province. (See les Voyag. Hist. de l'Europe, tom. v. p. 70.)

The harbour of Hithe, in the county of Kent, is entirely blocked up, notwithstanding much labour and expence bestowed, on different occasions, to clear it from rubbish. For several miles round, we find an astonishing quantity of shells and other sea-bodies, which had been accumulated in ancient times, and which are now covered with soil, and afford excellent pasturage. The sea, on the other hand, often encroaches upon the land. The lands of Goodwin, for example, which formerly belonged to a Nobleman of that name, are now converted into sands, and are covered with the waters of the ocean. Thus the sea gains upon some coasts, and loses upon others, according to their different situations and circumstances. (See Phil. Trans. abridg. vol. iv. p. 234.)

Upon Mount Stella in Portugal, there is a lake, in which are found the wrecks of ships, though this mountain is 12 leagues distant from the sea. (See Gordon's Geog. Gram. p. 149.) Sabinius, in his commentary upon Ovid's Metamorphoses, tells us, that, in 1460, a ship, with its anchors, were found in one of the Alpine mines.

These changes of sea into land, and of land into sea, are not peculiar to Europe. The other parts of the globe, if properly investigated, would furnish more striking and numerous examples.

Calecut was formerly a celebrated city, and the capital of a kingdom of that name. It is now reduced to an inconsiderable town, ill-built, and almost deserted. The sea, which, for a century past, has gained greatly upon this coast, now covers most of the ancient city. Ships moor upon its ruins, and the port is choaked up with a number of rocks, upon which many vessels have been wrecked. (See Lettres edifiantes, recueil. ii. p. 187.)

The province of Jucatan, a peninsula in the Gulf of Mexico, was formerly a part of the sea. This neck of land stretches about 100 leagues in length, and is no where above 25 leagues broad. The air is hot and moist. The earth furnishes plenty of water, though, in so large a country, there are neither rivers nor brooks; and, when pits are dug, such multitudes of shells every where appear, as leave no room for doubting that this whole tract of land was formerly a part of the ocean.

It is a tradition among the inhabitants of Malabar, that the Maldiva Islands originally belonged to the continent of India, and that they were detached from it by the violence of the ocean. The number of these islands is so great, and they are separated by such narrow channels, that the bow-sprits of vessels, in passing, drive off leaves from the trees on each side; and, in some places, a vigorous man, by laying hold of a branch, may leap into another island. (See Voyages des Hollandois aux Indes Orientales, p. 274.) The cocoa trees found at the bottom of the sea, is a farther proof that the Maldivas formerly belonged to the continent.

The island of Ceylon, those of Rammanakoiel, and many other islands, it is believed, were also disjoined from the continent by currents, which, in many places of the Indian Sea, are extremely rapid. (Ibid. vol. iv. p. 485.) It is certain, however, that the sea has encroached 30 or 40 leagues on the north-east coast of Ceylon.

The sea appears to have lately abandoned many of the promontories and islands of America. We have already remarked, that the territory of Jucatan is full of shells. The same phænomenon takes place in the low grounds of Martinico and the other Antilles. The inhabitants distinguish the earth below the surface by the name of *lime;* because they make lime of the shells, great banks of which lie immediately under the vegetable soil. (See Nouv. Voyages aux Isles de l'Amerique.)

There are some lands which the sea alternately covers and leaves bare, as happens in several islands of Norway, Scotland, the Maldivas, the Gulf of Cambaya, &c. The Baltic Sea has gradually gained a great part of Pomerania; and it has covered and destroyed the celebrated port of Vineta. In the same manner, the Norwegian sea has advanced into the continent, and formed several islands. The German Sea has encroached upon Holland, near Catt, to such a degree, that the ruins of an ancient Roman citadel, which was formerly situated on the coast, lie now at a considerable distance in the sea. The marshy ground in the isle of Ely, and the Crau of Provence, are, on the contrary, lands which the sea has deserted. The Downs have been formed by accumulations of sand, earth, and shells successively driven

upon the coasts by winds blowing from the sea. For example, on the west coasts of France, Spain, and Africa, a violent west wind reigns, by which the waters are pushed with violence against the shores; and downs, accordingly, are frequent on these coasts. The east winds, in the same manner, when they continue long, drive the waters so forcibly from the coasts of Syria and Phœnicia, that large chains of rocks, which are covered during the west winds, are left dry. Besides, downs are not composed of stones and marble, like the mountains which have been formed in the bottom of the ocean, because they have not remained long enough under the waters. That the waters of the sea possess a petrifying power, and that the stones formed in the earth are very different from those formed at the bottom of the ocean, is fully evinced in my discourse on minerals.

Since finishing my Theory of the Earth, which was composed in 1744, I have perused M. Barrere's dissertation on the Origin of figured Stones. It gave me peculiar satisfaction to find that the ideas of this accomplished naturalist, concerning the formation of downs, and the duration of the sea upon the surface of the earth which we inhabit, exactly corresponded with my own. Aiguis-mortes, which is now more than a league and a half from the sea, was a port in the time of St. Louis. Psalmodi was an island in 815; and it is now more than two leagues from the sea. The same change has happened at Maguelone. The greatest part of the vineyard of Agde was covered, about 40 years ago, with the waters of the sea. In Spain, the sea, within these few years, has retired considerably from Blanes, from Badalona, from the environs of the river Vogrebat, from Cape Tortosa, along the coast of Valencia, &c.

The sea may form hills and mountains: 1. By transporting earth, slime, sand, and shells from one place to another: 2. By depositing sediments composed of small particles detached from the bottom and from the coasts: and, lastly, hills and downs may be formed by sand and other particles driven against the coasts by particular winds; these are gradually deserted by the sea, and become parts of the dry land. The downs of Flanders and Holland are of this kind. They consist of small elevations or hills, composed of sand and shells which have been blown from the sea upon the coasts. M. Barrere gives another example which merits observation. 'The 'sea,' he remarks, 'by its motion, detaches immense 'quantities of plants, sand, shells, and slime from its 'bottom, which are continually pushed by the winds and 'the waves towards the coasts. The perpetual repetition 'of this operation must give rise to gradual accumula-'tions of new strata, which elevate the earth, produce 'downs and hills, enlarge the land, and confine the sea 'within narrower bounds.

'It is apparent that new strata of different materials 'must have been formed by the constant attrition of the 'waters, by the deposition of sediments, and by other 'causes, the operation of which has been co-eval with the 'existence of the globe itself. Of this we have a remarkable 'proof in the different strata of fossil shells, and other 'sea-bodies, found at Roussillon near the village of Naf-'fiac, which is 7 or 8 leagues from the sea. These beds of 'shells, which incline at different angles from west to 'east, are divided from each other by strata of earth and 'sand, somtimes of a foot and a half, and sometimes of 'two or three feet in thickness. In dry weather they 'seem as if sprinkled over with salt, and form a chain of 'hillocks from 25 to 30 fathoms high. A long chain of 'hillocks of such a height could not be formed at once, 'but gradually, and by a long succession of time. Effects 'somewhat similar might have been produced by an 'universal deluge. But, in this case, the different beds 'of fossil shells, instead of preserving a regular form, 'would have been blended together without any order.'

I entirely agree with the sentiments of M. Barrere, except as to the formation of mountains, which cannot be ascribed solely to those causes which increase the land, and diminish the boundaries of the ocean. On the contrary, I can produce several convincing arguments to prove that most of those eminences, which appear on the surface of the earth, have actually received their original formation in the sea itself: 1. Because they have corresponding angles, which necessarily imply the cause we have assigned, namely, the motion of the currents. 2. Because downs and hills, which have originated from materials thrown upon the coasts, are not, like common hills, composed of marble and hard stones. Besides, the shells found in the former are only in the fossil state; but those in the latter are entirely petrified. Neither is the position of the strata equally horizontal in downs, as in the hills composed of marble and hard stone. They are more or less inclined, as in the hills of Naffiac. On the contrary, in the hills and mountains formed by sediments under the waters of the sea, the strata are always parallel, and often horizontal; and the shells and other matter of them are completely petrified. I despair not of being able to prove, that the marbles and other calcareous bodies, which are almost all composed of madrepores, astroites, and shells, have acquired their density and perfection at the bottom of the ocean. But the tufas, soft stones, incrustations, stalactites, &c. which are likewise calcinable, and have been formed since the earth was left dry, can never acquire the degree of density and of petrifaction peculiar to marble and other hard stones.

The remarks of M. Saulmon concerning the *galets*, which are found in many places, may be seen in the history of the French Academy, anno 1707. These *galets* are round, flat, finely polished pieces of flint, thrown out by the sea upon the coasts. At Bayeux, and at Prutel, which is a league from the sea, galets are found in dig-

ging pits and wells. The mountains of Bonneuil, of Broie, and of Quesnoy, which are 18 leagues distant from the sea, are covered with galets. They are also found in the valley of Clermont, in Beauvois. M. Saulmon farther informs us, that a hole, 16 feet in length, was pierced horizontally into the high beach of Tresport, which consists of a soft earth; and that, in the space of 30 years, it was entirely obliterated by the sea. Supposing the sea to encroach uniformly upon this shore, it will gain half a league in 12,000 years.

The motions of the sea, therefore, must be regarded as the principal cause of all those changes which have already happened, and of those which are daily produced upon the surface of the earth. But there are other causes, which, though less considerable, have some effect in changing the superficial parts of this globe. The rivers, the brooks, the melting of snows, the torrents, the frosts, &c. have given rise to many alterations. The rains have diminished the height of the mountains; the rivers and brooks have elevated the plains, and dammed up the sea at their mouths; the torrents and the melting of snows have scooped out deep ravines or furrows in the valleys and narrow passages between the mountains; the frosts have split rocks, and detached them from their original stations: innumerable examples of revolutions produced by all these causes might be given. Varenius tells us, that the rivers transport into the sea vast quantities of earth, and deposite them at greater or lesser distances from the shore, in proportion to the rapidity of their currents. These portions of earth fall to the bottom, and first form small banks, which, by constant accessions, become shoals, and at last appear in the form of fertile and habitable islands. It is in this manner that the islands in the Nile, those in the river St. Laurence, the island of Landa, situated near the mouth of the river Coanza, on the coast of Africa, the Norwegian islands, &c. have received their existence, (see Varen. Geogr. p. 214.) To these may be added the island of Trongming in China, which has been gradually formed by matters brought down by the river Nankin, and deposited near its mouth. This island is more than 20 leagues in length, and from 5 to 6 in breadth. (See Lettres edifiant. rec. xi. p. 234.)

The Po, the Trento, and other rivers of Italy, bring down such quantities of earth into the *lagunes* of Venice, especially in the time of inundations, that they must be gradually filled up. Many parts of them are already dry during the ebb tide; and there is in them no depth of water, except in the canals, which are supported at an immense expence.

Large sand-banks are thrown up at the mouths of the Nile, of the Ganges, of the Indus, of the Plata, and of many other rivers. La Loubere, in his voyage to Siam, informs us, that the banks of sand and of earth augment daily, at the mouths of the great rivers of Asia, and to such a degree that the navigation of them becomes every hour more difficult, and will soon be impracticable. The same observation applies to the great rivers of Europe, and especially to the Wolga, which empties itself by more than 70 mouths into the Caspian, and to the Danube, which runs into the Black Sea by seven mouths, &c.

As it seldom rains in Egypt, the regular inundations of the Nile proceed from the torrents which fall into it from Æthiopia. It brings down vast quantities of mud, which it deposites annually not only upon the soil of Egypt, but throws it to great distances into the sea, where it is laying the foundations of a new country, which must arise, in the course of time, out of the bosom of the ocean; for, upon sounding at the distance of 20 leagues from the coast, the mud of the Nile is found at the bottom of the sea; and every year it receives fresh accumulations. The Lower Egypt, now called the *Delta*, was formerly a bay, (see Diodor. Sic. lib. 3. Aristot. de Meteor. lib. i. cap. 14. Herodot. § 4, 5, &c. Homer tells us, that the island of Pharos was a day and a night's voyage from Egypt; and now it is almost contiguous to the land. The soil of Egypt is not every where of an equal depth; it grows thinner the farther we remove from the sea. Near the banks of the Nile, there are sometimes more than 30 feet of good soil; but, at the extremity of the inundation, there are not, perhaps, above seven inches. All the cities of Lower Egypt have been built upon artificial eminences. (See Shaw's Travels.) The town of Damietta, which is now ten miles from the sea, was a part of the ocean in 1243. The town of Fooah, which, 300 years ago, was situated at the mouth of the Canopic branch of the Nile, is now seven miles distant from it. Within 40 years, the sea has retired half a league from Rosetto, &c. (See Shaw's Travels.)

Many changes have also taken place at the mouths of the great rivers of America, and even in those which have been but lately discovered. Charlevoix tell us, that, at the mouth of the Missisippi, below New Orleans, the land runs out into a point, which appears not to be very ancient; because, wherever the earth is dug, plenty of water is found; and besides, the many little islands which have recently appeared in all the mouths of this river, leave no room to doubt that this point of land was formed in the same manner. It is certain, says he, that, when M. Salle sailed down the Missisippi to the sea, the mouth of this river was considerably different from what it is now.

The nearer, he adds, we approach the sea, this difference becomes the more conspicuous. There is no water in most of the small channels cut in the bar by the river. These channels are greatly multiplied by the trees brought down by the current. A single tree, with its branches and roots, when stopped in a shallow part of

the river, will entangle a thousand. I have seen, says he, 200 leagues from New Orleans, different collections of trees, any one of which would fill all the wood-yards in Paris. Nothing can disentangle them. The mud brought down by the river serves as a cement, and gradually covers them. Every inundation leaves a new stratum; and, in a few years, plants and shrubs begin to grow. It is in this manner that most points of land and islands, which so often change the course of rivers, are originally produced.

All the revolutions, however, produced by rivers, are very slow, and become not considerable till after a long course of years. But those which are occasioned by inundations or earthquakes are sudden, and almost instantaneous. According to the Timæus of Plato, we are assured by the ancient priests of Egypt, 600 years before the birth of Christ, that there existed an island beyond the Pillars of Hercules, called *Atlantis*, which was larger than both Asia and Lybia taken together; and that this great island was sunk under the waters of the ocean by a terrible earthquake. 'Traditur Atheniensis civitas 'restitisse olim innumeris hostium copiis quæ, ex Atlan-'tico mari profectæ, propè cunctam Europam Asiamque 'obsederunt; tunc enim fretum illud navigabile, habens 'in ore et quasi vestibulo ejus insulam quam Herculis 'Columnas cognominant: ferturque insula illa Lybia 'simul et Asia Major fuisse, per quam ad alias proximas 'insulas patebat aditus, atque ex insulis ad omnem con-'tinentem è conspectu jacentem vero mari vicinam; sed 'intra os ipsum portus angusto sinu traditur, pelagus 'illud verum mare, terra quoque ille verè erat continens, '&c. Post hæc ingenti terræ motu jugique diei unius 'et noctis illuvione factum est, ut terra dehiscens omnes 'illos bellicosos absorberet, et Atlantis insula sub vasto 'gurgite mergeretur.' *Plato in Timæo.* This ancient tradition is not devoid of probability. The lands swallowed up by the waters were, perhaps, those which united Ireland to the Azores, and the Azores to the continent of America; for, in Ireland, there are the same fossils, the same shells, and the same sea bodies, as appear in America, and some of them are found in no other part of Europe.

Two evidences are mentioned by Eusebius on the subject of deluges: the one is Melo, who affirms, that all the plains of Syria were formerly laid under water: the other is Abidenus, who says, that, in the reign of King Sisithrus, there was a great deluge, which had been predicted by Saturn. Plutarch *De Solertia Animalium*, Ovid, and other mythologists, describe the deluge of Deucalion, which happened, they say, in Thessaly, about 700 years after the universal deluge. It is also alledged, that there was a still more ancient deluge in Attica, during the time of Ogiges, about 230 years before that of Deucalion. In the year 1095, a deluge in Syria drowned a prodigious number of people. (See Alsted. Chron. chap. 25.) In 1164, a deluge in Frizeland covered the whole environs of the coasts, and drowned several thousands of the inhabitants. (See Krank. lib. v. c. 4.) Another inundation, in 1218, destroyed 100,000 men. Of inundations there are many other examples.

Impetuous winds may be regarded as a third cause of changes on the surface of the globe. They not only give rise to downs and hills along the sea-coasts, but they often arrest rivers, make them regorge, and change their directions. They carry off cultivated lands, tear up trees, everturn houses, and cover whole countries with sand. Upon the coast of Brittany, in France, we have an example of these inundations of sand: the history of the Academy, ann. 1722, describes it in the following terms:

'In the environs of St. Paul de Leon, in Lower Brit-'tany, there is a province on the sea-coast, which, be-'fore the year 1666, was inhabited; but is now totally 'deserted, on account of the sand, which has covered it 'to the depth of 20 feet, and which daily gains ground. 'Reckoning from the above period, the sand has ad-'vanced about 6 leagues into the country; and it is now 'within half a league of St. Paul, and that town must 'probably soon be deserted. The tops of steeples, and 'of some chimneys, still appear above this ocean of 'sand. The inhabitants, however, have always had lei-'sure to quit their possessions in safety; (p. 7.)

'This calamity is augmented by an east, or a north 'wind, which elevate this fine sand, and carry it in such 'quantities, that M. Des Lands, to whom the Academy 'are indebted for the observation, when walking in this 'country during an east wind, found himself obliged to 'shake his hat and his garments from time to time, on 'account of the great weight of sand with which they 'were loaded. Besides, when the wind is violent, it 'carries the sand over a small arm of the sea as far as 'Roscof, a port much frequented by foreign vessels; 'and the sand accumulates in the streets of this village 'to the height of two feet, which obliges the inha-'bitants to drive it off in waggons. It may be further 'remarked, that the sand is mixed with ferruginous par-'ticles, which are recognisable by the magnet.

'The coast which furnishes this sand extends from 'St. Paul to Plouefeat, a space of more than four 'leagues; and it is nearly on a level with the sea when 'the tide is full. It is situated in such a manner that 'the east and north-east winds only can blow the sand 'in upon the country. It is easy to conceive how sand 'carried and accumulated into any place by the wind, 'may again be taken up by the same wind, and carried 'still farther. Thus the sand may continue advancing, 'and covering new lands, as long as the magazine from 'which it originally proceeds shall remain unexhausted; 'for, if the fountain were once dried up, the sand, by 'advancing, would diminish in depth, and its destructive

'consequences would gradually decay. But it is not 'improbable that the sea may long continue to supply 'fresh sand, and keep this baneful magazine in a con-'dition to do perpetual mischief.

'This disaster is not of an old date. Perhaps it was 'not till lately that the place was sufficiently stored to 'allow great quantities of sand to be carried off; or, 'perhaps, it has but recently been left uncovered by the 'waters. This coast has undergone some change. At 'present, the sea, at full tide, reaches half a league 'on this side of certain rocks, which it formerly never 'passed.

'This miserable province justifies what has been re-'lated, both by ancient and by modern travellers, that 'whole cities, and even vast armies have been buried 'by tempests of sand in the deserts of Arabia.'

Mr. Shaw relates, that the ports of Laodicea, Tortosa, Rowadsa, Tripoli, Tyre, Acra, and Jaffa, are blocked up with sand transported by the high waves which rise on that part of the coast of the Mediterranean, when the west winds blow with violence. (See Shaw's Travels.)

It is needless to give more examples of alterations on the surface of this globe. The fire, the air, and the waters, produce continual changes, which, in a succession of ages, become considerable. The sea and the land not only change places from the effects of general and stated periodic laws, but a number of revolutions are occasioned by particular and accidental causes, as earthquakes, inundations, sinkings of mountains, &c. Thus the surface of the earth, which we regard as the most permanent of all things, is subjected, like the rest of nature, to perpetual vicissitudes.

CONCLUSION.

FROM the proofs delivered in Art. VII. and VIII. it appears to be an established fact, that the whole surface of what is now dry land, was formerly buried under the waters of the ocean. It is equally clear, from Art. XII. that the flux and reflux, and other movements of the ocean, perpetually detach from the coasts and from the bottom of the sea, shells, and matter of every species; and that these are deposited in other places in the form of sediments, and give rise to the horizontal strata which every where appear. In the IX. Art. we have proved, that the inequalities on the surface of the globe have been occasioned by the motion of the waters of the sea; and that the mountains received their original formation from successive accumulations of sediments. It is likewise evident, from Art. XIII. that the currents which first followed the direction of these inequalities, afterwards bestowed on them their present figure, namely, their alternate and corresponding angles. From Art. VIII. and XVIII. it appears, that most of the matters detached from the coasts and from the bottom of the sea were, when deposited in sediments, in the form of a fine impalpable powder, which entirely filled the cavities of shells, whether this powder was of the same nature, or only analagous to the matter of which the shells were composed. It is undeniable, from Art. XVII. that the horizontal strata, which have been formed by successive accumulations of sediments, and which at first were soft and ductile, acquired density and compactness in proportion as they dried; and that the perpendicular fissures in the strata derived their origin from the act of drying.

After perusing Art. X. XI. XIV. XV. XVI. XVII. XVIII. and XIX. we must be convinced, that the surface of the earth has been disfigured by many revolutions and particular vicissitudes, arising from the operation of the waters, and the effects of rains, frost, rivers, winds, subterraneous fires, earthquakes, inundations, &c. and, consequently, that the sea has alternately changed places with the dry land, especially in the first ages after the creation, when terrestrial substances were much softer than they are at present. It must, however, be acknowledged, that our judgment concerning the succession of natural revolutions cannot fail to be very imperfect; that we are still less competent judges of those changes which owe their birth to fortuitous events; and that the defect of historic records deprives us of the knowledge of particular facts. We desiderate both time and experience. We never consider, that, though our existence here be extremely limited, nature proceeds in her course. We are ambitious of condensing into our momentary duration both the past and the future, without reflecting that human life is only a point of time, a single fact in the history of the operations of God.

GENERAL HISTORY OF ANIMALS.

CHAPTER I.

Analogies between Animals and Vegetables.

AMONG the numberless objects with which the surface of this globe is covered and peopled, animals hold the first rank, both on account of the relation they bear to man, and of their acknowledged superiority over vegetable and inanimated matter. The senses, the figure, and the motions of animals, bestow on them a more extensive connection with surrounding objects than is possessed by vegetables. The latter, however, from their expansion, their growth, and the variety of parts of which they are composed, are more intimately related to external objects than minerals or stones, which are perfectly inert, and deprived of every vital or active principle. It is this number of relations alone which render the animal superior to the vegetable, and the vegetable to the mineral. Man, if we estimate him by his material part alone, is superior to the brute creation only from the number of peculiar relations he enjoys by means of his hand and of his tongue; and, though all the operations of the Omnipotent are in themselves equally perfect, the animated being, according to our mode of perception, is the most complete; and man is the most finished and perfect animal.

What a variety of springs, of powers, and of mechanical movements, are included in that small portion of matter of which the body of an animal is composed! What a number of relations, what harmony, what correspondence among the different parts! How many combinations, arrangements, causes, effects, and principles, all conspiring to accomplish the same design! Of these we know nothing but by their results, which are so difficult to comprehend, that they cease only to be miraculous from our habits of inattention and our want of reflection.

But, however admirable this work may appear, the greatest miracle is not exhibited in the individual. It is in the successive renovation, and in the continued duration of the species, that Nature assumes an aspect altogether inconceivable and astonishing. This faculty of reproduction, which is peculiar to animals and vegetables; this species of unity which always subsists, and seems to be eternal; this generative power, which is perpetually in action, must, with regard to us, continue to be a mystery so profound, that we shall probably never reach its bottom. [The word *reproduction* is frequently used by the author, and requires to be explained. It signifies the power of producing or propagating in general, and is equally applicable to plants and to animals. Generation is a species of reproduction peculiar to animated beings.

Even inanimated bodies, the stones or the dust under our feet, have some properties; their very existence presupposes a great number; and matter, the most imperfectly organized, possesses many relations with the other parts of the universe. We will not assert, as some philosophers have done, that matter, under whatever form it appears, is conscious of its existence and of its relative powers. This question belongs to metaphysics, of which we intend not to treat. We shall only remark, that, being ignorant of the extent of our own connections with external objects, we cannot hesitate in pronouncing inanimated matter to be infinitely more ignorant. Besides, as our sensations have not the most distant resemblance to the causes which produce them, analogy obliges us to conclude, that dead matter is neither endowed with sentiment, with sensation, nor with a consciousness of its own existence. Hence, to attribute any of these faculties to matter, would be ascribing to it the power of thinking, of acting, and of perceiving, nearly in the same manner as we ourselves think, act, and perceive; which is equally repugnant to reason and religion.

With inanimated matter, therefore, though formed of dust and clay, we have no other relations than what arise from the general properties of bodies, such as, extension, impenetrability, gravity, &c. But, as relations purely material make no internal impression on us, and, as they exist entirely independent of us, they cannot be considered as any part of our being. Our existence, therefore, is an effect of organization, of life, of the soul. Matter, in this view, is not a principal, but an accessory. It is a foreign covering, united to us in a manner unknown; and its presence is noxious. Thought is the constituent principle of our being, and is perhaps totally independent of matter.

We exist, then, without knowing how; and we think, without perceiving the reason of thought. But, whatever be the mode of our being, or of our thinking,

whether our sensations be real or apparent, their effects are not the less certain. The train of our ideas, though different from the objects which occasion them, gives rise to genuine affections, and produces in us relations to external objects, which we may regard as real, because they are uniform and invariable. Thus, agreeable to the nature of our being, it is impossible to doubt concerning the reality of those distinctions and resemblances which we perceive in the bodies that surround us. We may, therefore, conclude, without hesitation, that man holds the first rank in the order of nature; and that brute animals hold the second, vegetables the third, and minerals the last. Though we are unable clearly to distinguish between our animal and spiritual qualities; though brutes are endowed with the same senses, the same principles of life and motion, and perform many actions in a manner similar to those of man; yet they have not the same extent of relation to external objects; and, consequently, their resemblance to us fails in numberless particulars. We differ still more from vegetables; but we are more analogous to them than to minerals; for vegetables possess a species of animated organization; but minerals have nothing that approaches to regular organs.

Before we give the history of an animal, it is necessary to have an exact knowledge of the general order of his peculiar relations, and then to distinguish those relations which he enjoys equally with vegetables and minerals. An animal possesses nothing common to the mineral but the general properties of matter: his nature and œconomy, however, are perfectly different. The mineral is inactive, insensible, subject to every impulse, without organization, or the power of reproduction, a rude mass, fitted only to be trod by the feet of men and of animals. Even the most precious metals, which derive their value from the conventions of men only, are regarded in no other light by the philosopher. In the animal, the whole powers of nature are united. The principles with which he is animated are peculiar to him: he wills; he determines; he acts; he communicates, by his senses, with the most distant objects: his body is a world in miniature, a central point to which every thing in the universe is connected. These are his peculiar and invariable relations. The faculties of growth and expansion, of reproduction and the multiplication of his species, he possesses in common with the vegetable kingdom.

Progressive motion appears to be the most distinguishing quality between an animal and a vegetable. We, indeed, know no vegetable that enjoys a loco-motive faculty. But this motion is denied to several species of animals, as oysters, gall-insects, &c. This distinction, therefore, is neither general nor essential.

Sensation more essentially distinguishes animals from vegetables. But *sensation* is a complex idea, and requires some *explication;* for, if sensation implied no more than motion consequent upon a stroke or impulse, the sensitive plant enjoys this power. But, if by sensation we mean the faculty of perceiving and of comparing ideas, it is uncertain whether brute animals are endowed with this faculty. If it should be allowed to dogs, elephants, &c. whose actions seem to proceed from motives similar to those by which men are actuated, it must be denied to many species of animals, particularly to those that appear not to possess the faculty of progressive motion. If the sensation of an oyster, for example, differ in degree only from that of a dog, why do we not ascribe the same sensation to vegetables, though in a degree still inferior? This distinction, therefore, between the animal and vegetable, is neither sufficiently general nor decided.

A third distinction has been derived from the manner of feeding. Animals have organs of apprehension by which they lay hold of their food; they search for pasture, and have a choice in their aliment. But plants are under the necessity of receiving such nourishment as the soil affords them, without exerting any choice in the species of food, or in the manner of acquiring it. The moisture of the earth is the only source of their nourishment. However, if we attend to the organization and action of the roots and leaves, we shall soon be convinced, that these are the external organs by which vegetables are enabled to extract their food; that the roots turn aside from a vein of bad earth, or from any obstacle which they meet with in search of a better soil; and that they split and separate their fibres in different directions, and even change their form in order to procure nourishment to the plant. A general distinction, therefore, between the animal and vegetable, cannot be founded on their manner of feeding.

From this investigation we are led to conclude, that there is no absolute and essential distinction between the animal and vegetable kingdoms; but that nature proceeds by imperceptible degrees from the most perfect to the most imperfect animal, and from that to the vegetable: hence the fresh water polypus may be regarded as the last of animals, and the first of plants.

After examining the distinctions, we shall now inquire into the resemblances which take place between animals and vegetables. The power of reproduction is common to the two kingdoms, and is an analogy both universal and essential. This mutual faculty would induce us to think that animals and vegetables are beings of the same order.

A second resemblance may be derived from the expansion of their parts, which is likewise a common property; for vegetables grow as well as animals; and, though some difference in the manner of expansion may

be remarked, it is neither general nor essential; since the growth of some considerable parts of animals, as the bones, the hairs, the nails, the horns, &c. is the effect of a genuine vegetation; and the fœtus, in its first formation, may be rather said to vegetate than to live.

A third resemblance arises from the following fact: some animals are propagated in the same manner and by the same means, as vegetables. The multiplication of the vine-fretter, (*puceron*), which is effected without copulation, is similar to that of plants by seed; and the multiplication of the polypus by cuttings resembles that of plants by slips.

We may, therefore, conclude, with more certainty, that animals and vegetables are beings of the same order, and that Nature passes from the one to the other by imperceptible degrees; since the properties in which they resemble each other are universal and essential, while those by which they are distinguished are limited and partial.

Let us next compare animals and vegetables in different points of view; for example, with regard to number, situation, magnitude, figure, &c. from which new inductions will arise.

Animals exceed plants in the number of species. In the class of insects alone, there are, perhaps, a greater number of species, than of the whole species of plants on the face of the earth. Animals differ from each other much more than plants: it is the great similarity of plants that has given rise to the difficulty of distinguishing and arranging them, and to the variety of botanical systems, which are much more numerous than those of zoology.

Beside being more strongly characterised, every species of animal is distinguishable from another by copulation. Those may be regarded as of the same species which, by copulation, uniformly produce and perpetuate beings every way similar to their parents; and those which, by the same means, either produce nothing, or dissimilar beings, may be considered as of different species. A fox, for example, will be of a different species from a dog, if nothing results from the intercourse of a male and a female of these two animals; or, if the result be a dissimilar creature, a kind of mule, as this mule cannot multiply, it will be a sufficient demonstration that the fox and dog are different species of animals. In plants, we have not the same advantage; for, though sexes have been attributed to them, and generic distinctions have been founded on the parts of fructification; yet, as these characteristics are neither so certain nor so apparent as in animals; and, as the reproduction of plants can be accomplished by several methods which have no dependence on sexes, or the parts of fructification, this opinion has not been universally received; and it is only by the misapplication of analogy, that the sexual system has been pretended to be sufficient to enable us to distinguish the different species of the vegetable kingdom.

Though the species of animals be more numerous than those of plants, the number of individuals in each species of the latter far exceed those of the former. In animals, as well as in plants, the number of individuals is much greater in the small than in the large kinds. Flies are infinitely more numerous than elephants; and there are more herbs than trees. But, if we compare the number of individuals in each species, the individuals in each species of plant far exceed those of the animal. Quadrupeds, for example, produce but few at a time, and at considerable intervals. Trees, on the contrary, produce annually an amazing number of seeds. It may be alledged, that, to render this comparison exact, the number of seeds produced by a tree should be compared with the number of germs contained in the semen of an animal; and then, perhaps, it would appear, that animals abound more in germs than vegetables. But, by collecting and sowing the seeds of a single elm tree, 100,000 young elms may be raised from the product of one year. Though a horse, however, were furnished with all the mares he could cover in a year, the result between the production of the animal and of the plant would be very different. I avoid taking notice of the number of germs; because of these, especially in the animal, we have no certain knowledge, and because the same seminal germs may exist in the vegetable; for the seed of a plant is not a germ, but a production as perfect as the fœtus of an animal, and which, like a fœtus, requires only the expansion of its parts.

To this may be opposed the prodigious multiplication of some kinds of insects, as the bee, a single female of which will produce 30 or 40 thousand. But, it ought to be remarked, that I am here speaking in general of animals compared with vegetables. Besides, the bee, which affords perhaps an example of the greatest multiplication among animals, proves nothing against the present doctrine; for, out of 30 or 40 thousand flies produced by the mother-bee, there are but very few females, and no less than 1500 or 2000 males: the rest are of neither sex, and totally incapable of procreating.

It must be acknowledged, that some species of insects, fishes, and shell-animals, appear to be extremely prolific. Oysters, herrings, fleas, &c. are perhaps equally fertile as mosses, and the most common plants. But, in general, most species of animals are less prolific than plants; and, upon comparing the multiplication of the different species of plants, we find not such remarkable differences, with regard to number, as take place among animals. Some animals produce great numbers, and others very few. But, in every species of plants, the quantity produced is always great.

From what we have already observed, it appears, that,

both in the animal and vegetable kingdoms, the smallest and most contemptible species are the most prolific. In proportion as animals seem to be more perfect, the number of individuals decreases. Does the production of particular forms of body, necessary for the perfecting of sentiment, as those of quadrupeds, and of birds, cost nature more expence of organic particles than the production of inferior creatures?

Let us now compare animals and vegetables with regard to situation, size, and figure. Vegetables can exist no where but on the earth. Most of them are attached to the soil by roots. Some, as truffles, are entirely covered with the soil; and a few grow under water. But the whole require a connection with the surface of the earth. Animals, on the contrary, are more generally diffused. Some inhabit the surface, and others the interior parts of the earth. Some never rise above the bottom of the ocean, and others swim in the waters. The air, the internal parts of plants, the bodies of men and of other animals, and even stones themselves, are stored with inhabitants.

By the assistance of the microscope, many new species of animals have been discovered. But, what is singular, we are not indebted to this instrument for above one or two species of plants. The small moss, of which mouldiness consists, is perhaps the only microscopic plant that has been described. From this it would appear, that nature has refused existence to very small plants, while she has created animalcules in the greatest profusion. But this opinion should not be adopted without examination. Plants are so similar in their structure, that it is much more difficult to distinguish them than animals. This mouldiness, which we imagine to be only a very small moss, may be a forest or a garden consisting of a multitude of different plants, though we are unable to distinguish them.

Animals and vegetables differ also with regard to size. There is a greater disproportion between the bulk of a whale and that of one of these pretended microscopic animals, than between the largest oak and the small moss mentioned above. Though bulk be only a relative attribute, it may be useful to know the limits within which nature has confined her productions. As to largeness, plants differ but little from animals. The quantity of matter in a whale and in a large tree is nearly equal; but, as to smallness, some men have pretended to have seen animals so extremely minute, that a million of them collected in a heap would not equal the small moss on a piece of mouldy bread.

The most general and most obvious distinction between plants and animals arises from their figure. The form of animals, though infinitely various, has no resemblance to that of plants: and, though the polypi, which, like plants, can be multiplied by cuttings, may be regarded as the link which connects the animal and vegetable kingdoms, not only from the manner of their reproduction, but still more from their figure; yet there is no danger of mistaking the one for the other. The operations of some animals resemble plants or flowers. But plants never produce any thing similar to an animal; and those wonderful insects which make corals, would never have been mistaken for flowers, if, by a foolish prejudice, coral had not been regarded as a plant. Thus the errors we may commit in comparing plants and animals, are confined to a few objects which lie on the extremities of the two kingdoms; and the farther we extend our observations, we shall be the more convinced, that the Creator has instituted no fixed limits between the animal and vegetable; that these two species of organized beings possess a greater number of common properties than of real differences; that the production of an animal requires, perhaps, a smaller exertion of nature than the production of a vegetable; or rather, that the production of organized bodies requires no immediate exertion at all; and, lastly, that animation, or the principle of life, instead of a metaphysical step in the scale of being, is a physical property common to all matter.

CHAPTER II.

Of Reproduction in general.

WE shall now examine more closely this property, which is common to the animal and vegetable, this faculty of producing beings similar to themselves, this successive chain of individuals which constitutes the real existence of the species: and, without limiting our research to the generation of man, or of any particular animal, let us contemplate the general phænomena of reproduction; let us collect facts, and enumerate the various methods employed by nature for the renovation and transmission of organized existences.

The first, and apparently the most simple method, is to assemble in one body an infinite number of similar organic bodies, and to compose its substance in such a manner, that every part shall contain a germ or embryo of the same species, and which might become a whole of the same kind with that of which it constitutes a part. This apparatus appears, at first sight, to suppose a profusion of expence. Such magnificence, however, is not uncommon in nature. It is discernible even in the more common and inferior species, as in worms, polypi, elms, willows, and many other plants and insects, every part of which contains a whole, and, in order to become a plant or an insect, requires only to be unfolded or expanded. Considering organized bodies under this point of view, an individual is a whole uniformly constructed in all parts, a collection of an infinite number of particles every way similar, an assemblage of germs, or minute individuals of the same species, which, in certain circumstances, are capable of being expanded, and of becoming new beings like those from which they were originally separated. [The intelligent reader will perceive that this sentence, though not very obvious, contains the principle upon which the subsequent theory of generation adopted by the author is founded. It means no more than that the bodies of animals and of vegetables are composed of an infinite number of organic particles, perfectly similar, both in figure and substance, to the whole animal or plant, of which they are the constituent parts.]

This idea, when traced to the bottom, discovers a relation between animals, vegetables, and minerals, which we would not have suspected. Salts, and some other minerals, consist of parts similar to one another, and to the whole. A grain of sea-salt, as we distinctly perceive by the microscope, is a cube composed of an infinite number of smaller cubes, which, as we discover by a large magnifier, are themselves composed of still smaller cubes. The primitive and constituent particles of this salt must, therefore, unquestionably consist of cubes so minute, that they will for ever escape our observation. Plants and animals, which possess the power of multiplying by all their parts, are organized bodies composed of similar organic bodies, the primitive and constituent particles of which are also organic and similar. Of these we discern the accumulated quantity; but we can only recognise the constituent particles by reason and analogy. [Hæ tam parvæ quam magnæ figuræ (salium) ex magno solum numero minorum particularum, quæ eandem figuram habent, sunt conflatæ, sicuti mihi sæpe licuit observare, cum aquam marinam aut communem in qua sal commune liquatum erat, intueor per microscopium, quod ex ea prodeunt elegantes, parvæ, ac quadrangulares figuræ adeo exiguæ, ut mille earum myriades magnitudinem arenæ crassioris ne æquent. Quæ salis minutæ particulæ, quam primum oculis conspicio, magnitudine ab omnibus lateribus crescunt, suam tamen elegantem superficiem quadrangularem retinentes, fere . . . . . Figuræ hæ salinæ cavitate donatæ sunt, &c. *See Leeuwenhoek, Arc. Nat. tom.* I. *p.* 3.]

From this view we are led to conclude, that there exists in nature an infinity of *organic, living particles*, of the same substance with organized beings. A similar structure we have already remarked in more inanimated matter, which is composed of an infinite number of minute particles that have an exact resemblance to the whole body. And, as the accumulation perhaps of millions of cubes are necessary to the formation of a single grain of sea-salt that is perceptible by our senses, an equal number of similar organic particles are requisite to produce one of those numberless germs contained in an elm, or in a polypus. A cube of sea-salt must be dissolved, before we can discover, by means of crystallization, the minute cubes of which it is composed. In the same manner, the parts of an elm or of a polypus must be separated, before we can recognise, by means of vegetation, or expansion, the small elms or polypi contained in the different parts of these bodies. [To avoid the introduction of terms which might not be generally understood, it is necessary to inform the reader that the phrases *corps organiques vivans, parties organiques vivantes*, et *molecules organiques vivantes*, which occur so often in this volume, and form the basis of our

author's theory, are uniformly, in the version, expressed by the words *organic particles*.]

The difficulty of assenting to this idea proceeds from the well known prejudice, that we can only judge of the compound by the simple; that, to discover the organic structure of any being, it must first be reduced to its simple and unorganic parts; and that hence it is more easy to conceive how a cube must necessarily be composed of other cubes, than how a polypus can be composed of other polypi. But, if we examine attentively what is meant by simple and compound, we shall find, that in this, as in every thing else, the plan of nature is very different from the grossness and imperfection of our conceptions.

Our senses, it is well known, convey not to us exact representations of external objects. When we want to calculate, to judge, to compare, to weigh, to measure, &c. we are obliged to have recourse to foreign aid, to rules, to principles, to usages, to instruments, &c. All these adminicles are efforts of human genius, and belong more or less to the abstraction of our ideas. This abstraction, with regard to us, constitutes the simplicity of things; and the difficulty of reducing them to this abstraction is the compound. Extension, for example, being a general and abstract property of matter, is not much compounded. In order, however, to judge concerning it, we have imagined some extensions to have no thickness, others to have neither thickness nor breadth, and points, which are extensions without being extended. All these abstractions have been invented as supports to the understanding; and the few definitions employed in geometry have given rise to numberless prejudices and false conceptions. Whatever is reducible under any of these definitions is called simple; and such things as cannot be easily reduced to this standard are considered as complex. Thus, a triangle, a square, a circle, a cube, and also those curves of which we know the geometrical properties, are regarded as simple. But every thing which we cannot reduce under these figures, or abstract rules, appears to us to be complex. We never reflect, that all these geometrical figures exist no where but in our own imaginations, or that, if they are ever found in Nature, it is only because she exhibits every possible form; and the appearance of simple figures, as an exact cube, or an equilateral pyramid, is, perhaps, more difficult and rare to be found in Nature, than the complex forms of plants or of animals. It is in this manner that we perpetually consider the abstract as simple, and the real as complex. But, in nature, no abstract exists; nothing is simple; every object is compounded. We are unable to penetrate into the intimate structure of bodies. We cannot, therefore, determine what objects are more or less complex, unless by the greater or less relation they have to ourselves, and to the rest of the universe. For this reason we regard the animal as being more complex than the vegetable, and the vegetable than the mineral. With respect to us, this notion is just; but we know not whether the animal, vegetable, or mineral, be, in reality, the most complex or the most simple; and we are ignorant whether the production of a globe or a cube requires a greater effort of Nature than that of a germ, or an organic particle. If we were to indulge in conjectures upon this subject, we might imagine that the most common and numerous objects are the most simple. But this would make animals more simple than plants or minerals; because the former exceed the latter in number of species.

But, without dwelling longer on this subject, it is sufficient to have shown, that all our notions concerning simple and compound are abstract ideas; that they cannot be applied to the complex operations of nature; that, when we attempt to reduce all bodies into elements of a cubical, prismatic, globular, or any other regular figure, we substitute our own imaginations in opposition to real existences; and that the forms of the constituent particles of different bodies are absolutely unknown to us; and, of course, we may believe or suppose that organized beings are composed of similar organic particles, as well as that a cube consists of other cubes. We have no other method of judging but by experience. We know that a cube of sea-salt is composed of many lesser cubes, and that an elm consists of a great number of minute elms; because if we take a piece of a branch, of a root, of the wood separated from the trunk, or a seed, from all these a new tree is produced. The polypus, and some other species of animals, may likewise be multiplied by cuttings separated from any part of their bodies; and, as our rule of judging in both cases is the same, why should we form a different opinion concerning them?

The above reasoning renders it extremely probable, that there really exists in Nature an infinite number of small organized beings, every way similar to those large organized bodies which make such a conspicuous figure in this world; that these small organized beings are composed of living organic particles, which are common both to animals and vegetables, and are their primary and incorruptible elements; that an assemblage of these particles constitutes an animal or a plant; and, consequently, that reproduction or generation is nothing but a change of form, effected solely by the addition of similar particles; and the death, or resolution of organized bodies, is only a separation of the same particles. Of the truth of this doctrine, not a doubt will remain, after the proofs delivered in the following chapters are perused. Besides, if we reflect on the growth of trees, and consider what an immense mass is produced from so small an origin, we must be persuaded that this increase of matter is effected by the simple addition of organic

particles which are similar to one another and to the whole. The seed first produces a small tree, which it contained in miniature within its coats. At the top of this small tree a bud is formed, which contains the tree that is to spring the next season; and this bud is an organized body similar to the small tree of the preceding year. The small tree of the second year, in the same manner, produces a bud which contains a tree for the third year; and this process uniformly goes on as long as the tree continues to vegetate: buds are likewise formed at the extremity of each branch, which contain, in miniature, trees similar to that of the first year. It is evident, therefore, that trees are composed of minute organized bodies similar to themselves, and that the whole individual is formed by a numerous assemblage of minute and similar individuals.

But, it may be demanded, were not all these minute, and similarly organized bodies, contained in the seed? and may not the order of their unfolding be traced from that source? for it is apparent, that the first bud was surmounted by a similar bud, which was not expanded till the second year, and the third bud was not unfolded till the third year; and, consequently, the seed may be said to have really contained the whole buds which would be formed for 100 years, or till the dissolution of the plant: it is also apparent, that this seed contained not only all the small organized bodies which must in time have constituted the individual tree itself, but likewise all the seeds, and all the individuals which would successively arise, till the final destruction of the species.

This, indeed, is a capital difficulty: we shall therefore examine it with the greater attention. It is true, that the seed produced a small tree the first year, solely by the unfolding of the bud or germ which it contained, and that this small tree existed in miniature in the bud. But it is not equally certain that the bud of the second year, and those of the succeeding years, nor that all the small organic bodies, and the seeds which must have been formed till the end of the world, or the destruction of the species, were contained in the first seed. This opinion supposes an infinite progression, and makes every individual a source of eternal generations. The first seed, for instance, must have included all the plants of its species which have existed, or ever will exist; and the first man must have contained in his loins all the men who have appeared, or ever will appear, on the face of the earth. Every seed, and every animal, according to this doctrine, must have included in its own body an infinite posterity. If we yield to reasonings of this kind, we must lose sight of truth in the labyrinths of infinity; and, in place of solving, or of throwing light upon the question, we will involve it in tenfold obscurity. It is removing the object beyond the reach of our vision, and then complaining that it cannot be seen.

Let us investigate the nature of the ideas of infinite progression and expansion. How do we acquire them? In what do they instruct us? We derive the idea of infinity from the idea of what is limited. It is in this manner we obtain the ideas of infinite succession, and geometrical infinity: every individual is a unit; several individuals make a limited number; and a whole species is to us an infinite multitude. From the same data by which we have demonstrated the nonentity of geometrical infinity, we might prove, that infinite succession, or propagation, rests on no firmer basis; that it is only an abstract idea, a mere deduction from the idea of finite objects, by lopping off the limits which necessarily terminate every magnitude; (see this fully demonstrated in my preface to the French translation of Newton's Fluxions, p. 7.) and, of course, that every opinion which infallibly leads to the idea of actual existence, upon no better authority than what is derived from geometrical or numerical infinity, ought to be rejected.

The partizans of this opinion are now reduced to the necessity of acknowledging, that their infinity of succession and of multiplication is only an indeterminable or indefinite number. But, say they, the first seed, of an elm, for example, which weighs not a grain, actually contains all the organic particles requisite for the formation of this tree, and of all the individuals of the same species which shall ever appear. Is this a solution of the difficulty? Is it not cutting the knot, in place of untying it?

When, in reply to the question, how beings are multiplied? it is answered, that the multiplication was completed in the creation of the first individuals, is not this both an acknowledgment of ignorance, and a renouncing of all desire of farther improvement? We ask how one being produces its like? and we receive for answer, that the whole was created at once. A strange solution; for, whether one only or a thousand generations had passed, the same difficulty remains, and, instead of removing it, the supposition of an indefinite number of germs, all existing and contained in a single germ, increases and renders it altogether incomprehensible.

I allow that it is much easier to find fault, than to investigate truth, and that the question concerning reproduction is perhaps of such a subtile nature, as not to admit of a full and satisfactory explication. But we ought at least to inquire whether it be altogether inscrutable; and, in the course of this inquiry, we will discover all that can be known, and the reason why we can know no more.

Questions or inquiries are of two kinds; the first regard primary causes, the other particular effects. If, for example, it be asked why matter is impenetrable? we must either return no answer, or reply by saying, that matter is impenetrable, because it is impenetrable. The same answer must be made, if we inquire into the cause

of gravity, of extension, of the inertia of bodies, or of any general quality of matter. Such is the nature of all general and abstract qualities, that, having no mode of comparing them with other objects in which they do not exist, we are totally incapable of reasoning concerning them; and therefore all inquiries of this kind, as they exceed the powers of human intellect, are perfectly useless.

But, on the other hand, if the reason of particular effects be demanded, we are always in a condition to give a distinct answer, whenever we can show that these effects are produced by one of the general causes; and the question is equally solved, whether the particular effect proceeds immediately from a general cause, or from a chain of successive effects, provided we have a clear conception of the dependence of these effects upon each other, and of their mutual relations.

But, when a particular effect appears not to have any dependence upon more general effects, or has no analogy to those already known, we are then totally unable to give any explication of such effect; because we have no similar object with which it can be compared. We cannot explain a general cause, because it equally exists in every object; and, on the contrary, we can give no account of a single or isolated effect; because the same quality exists not in any other subject. To explain a general cause, we must discover one still more general; but a single and detached effect may be illustrated by the discovery of an analogous effect, which experience or accident may exhibit.

There is still another kind of question, which may be called a question of fact. For example, why do trees, dogs, &c. exist? All questions of this kind are perfectly insolvable; for those who solve them by final causes consider not that they mistake the effect for the cause. The relation of particular objects to ourselves has no connection with their origin. Moral affinity or fitness can never become a physical reason.

Questions in which we employ the word *Why*, ought to be carefully distinguished from those in which we employ *How*, and still more from those in which we ought to use the words *how much* or *how many*. *Why* always relates to the cause of the effect, or to the effect itself; *how* relates to the manner in which the effect happens; and *how much* relates to the measure or quantity of the effect.

These distinctions being established, let us now examine the question concerning the reproduction of beings. If it be demanded *why* animals and vegetables continue their species? we clearly perceive that this is a question of fact, and therefore it is useless and insolvable. But, if it be asked *how* animals and vegetables are reproduced? we are enabled to solve the question, by giving the history of the generation of every species of animal, and of the reproduction of every species of plant. After tracing, however, every possible method of propagation, and making the most exact observations, we have learned the facts only, but have not discovered the causes: and, as the means nature employs in multiplying and containing the species, seem to have no relation to the effects produced, we are still under the necessity of asking, by what secret cause she enables beings to propagate their kinds?

This question is very different from the first and second. It admits of nice scrutiny, and even allows us to employ the powers of imagination. It is, therefore, by no means insolvable; for it belongs not to a general cause. Neither is it solely a question of fact: and if we can conceive a method of reproduction, depending on primary causes, or which, at least, is not repugnant to them, we ought to be satisfied with it; and the more relation it has to the other effects of nature, it will rest upon a firmer basis.

By the nature of the question, then, we are permitted to form hypotheses, and to choose that which appears to have the greatest analogy to the other phænomena of nature. But we ought to reject every hypothesis which supposes the thing to be already accomplished; such, for example, as that which supposes the first germ to contain all the germs of the same species, or that every reproduction is a new creation, an immediate effect of the will of the Deity; for all hypotheses of this kind are mere matters of fact, concerning which it is impossible to reason. We must likewise reject every hypothesis which is founded on final causes, such as, that reproduction is ordained in order to replace the living for the dead; that the earth may always be covered with vegetables and peopled with animals; that men may be supplied with abundance of nourishment, &c.; for such hypotheses, in place of explaining the effect by physical causes, stand on no other foundation than arbitrary relations and moral affinities. We ought, at the same time, to despise those general axioms and physical problems so frequently and so injudiciously employed as principles by some philosophers, such as, 'Nulla fœcundatio extra corpus;' every living creature proceeds from an egg; generation always supposes sexes, &c. These maxims must not be taken in an absolute sense; they signify no more than that the thing happens more commonly in this manner than in any other.

Let us then endeavour to find an hypothesis that will be liable to none of these defects or incumbrances; and, if we shall not succeed in explaining the mechanism employed by nature for the reproduction of beings, we shall, at least, be able to approach nearer to the truth than we have hitherto reached.

In the same manner as we make moulds by which we can bestow on the external parts of bodies whatever

figure we please, let us suppose, that nature can form moulds by which she bestows on bodies both an external and internal figure; would not this be one method by which reproduction might be effected?

Let us first consider whether this supposition be well founded; let us examine whether it contains any thing that is absurd or contradictory; and then we shall discover what consequences may be drawn from it. Though our senses reach not beyond the external parts of bodies, we have clear ideas of their different figures and external affections, and we can imitate nature, by representing external figures in different ways, as by painting, by sculpture, and by moulds. But, though our senses be limited to external qualities, we know that bodies possess internal qualities, some of which are general, as gravity. This quality or power acts not in proportion to the surfaces, but to the masses, or quantities of matter. Thus there are in nature powers, and even of the most active kind, which penetrate the internal parts of matter. We are unable to form distinct ideas of such qualities; because, not being external, they fall not under the cognisance of our senses. But we can compare their effects, and may draw analogies from them, in order to account for the effects of similar qualities.

If our eyes, instead of representing to us the surfaces of bodies only, were so constructed as to perceive their internal parts alone, we should then have clear ideas of the latter, without knowing any thing of the former. Upon this supposition, moulds for the internal constitution, which I have supposed to be employed by nature, would be equally obvious and easy to conceive as moulds for the external figures of bodies; and we should then be in a condition to imitate the internal parts of bodies, as we now imitate the external. These internal moulds, though beyond our reach, may be in the possession of nature, as she endows bodies with gravity, which penetrates every particle of matter. The supposition of internal moulds being thus founded on analogy, let us next examine whether it involves any contradiction.

It may be alledged, that the expression, *internal mould*, includes two opposite and contradictory ideas; for the idea of a *mould* relates only to the surface; but the idea of internal, as here employed, has a relation to the whole mass; and therefore we might, with equal propriety, talk of a massy surface as of an internal mould.

I allow, that when ideas are attempted to be represented which have never been expressed, we are sometimes obliged to use terms that are apparently contradictory. To avoid this inconvenience, philosophers have been accustomed to employ unusual terms, instead of those which have a received signification. But this artifice is of no use, when we can show, that the seeming contradiction lies in the words, and not in the idea. A simple idea, however, cannot include a contradiction; *i. e.* whenever we can form an idea of a thing, if this idea be simple, it cannot be complex; it can include no other idea; and, of course, it can contain nothing that is opposite or contradictory.

Simple ideas are not only the first apprehensions received by the senses, but the first comparisons which we form of these apprehensions: for the first apprehension is always the result of comparison. The idea of the largeness or distance of an object necessarily implies a comparison with bulk or distance in general. Thus, when an idea includes nothing more than comparison, it ought to be regarded as simple; and, consequently, it can contain nothing contradictory. The idea of an internal mould is of this species. There is in nature a quality known by the name of gravity, which penetrates the internal parts of bodies. I understand the idea of an internal mould to be relative to gravity; and, therefore, as it includes only a comparison, it can imply no contradiction.

Let us now trace the consequences which may be drawn from this supposition; let us likewise investigate such facts as may correspond with it; and the more analogies we can collect, the supposition will be rendered the more probable. We shall begin with unfolding the idea of internal moulds; and then explain how it may lead us to conceive the mode of reproduction.

Nature, in general, appears to have a greater bias towards life than death: she seems anxious to organise bodies as much as possible. Of this the multiplication of germs, which may be infinitely increased, is a convincing proof; and it may be safely affirmed, that, if all matter is not organized, it is only because organized beings destroy one another; for we can increase at pleasure the number of animals and vegetables; but we cannot augment the quantity of stones or of dead matter; which seems to indicate, that the most ordinary and familiar operation of nature is the production of organized bodies; and here her power knows no limitation.

To render this idea more plain, we shall calculate what may be produced by a single germ. The seed of an elm, which weighs not above the hundredth part of an ounce, will, in 100 years, form a tree, of which the mass will amount to ten cubic fathoms. But, at the tenth year, this elm will have produced 1000 seeds, each of which, in 100 years more, will consist of ten cubic fathoms. Thus, in the space of 110 years, more than 10,000 cubic fathoms of organized matter are produced. Ten years after, we shall have ten millions of fathoms, without including the annual increase of 10,000, which would amount to 100,000 more; and, in ten years more, the number of cubic fathoms would be 10,000,000,000,000. Hence, in 130 years, a single germ would produce a mass of organized matter equal to 1000 cubic leagues; for a cubic league contains only about 10,000,000,000 cubic

fathoms. Ten years after, this mass would be increased to a thousand times a thousand leagues, or one million of cubic leagues; and, in ten more it would amount to 1,000,000,000,000 cubic leagues; so that, in the space of 150 years, the whole globe might be converted into organized matter of a single species. Nature would know no bounds in the production of organized bodies, if her progress were not obstructed by matter which is not susceptible of organization; and this is a full demonstration that she has no tendency to increase brute matter; that her sole object is the multiplication of organized beings; and that in this operation, she never stops but when irresistible obstacles occur. What we have remarked concerning the seed of an elm may be extended to any other germ; and it would be easy to show, that, by hatching all the eggs which are produced by hens for a course of 30 years, the number of fowls would be so great as to cover the whole surface of the earth.

Calculations of this kind evince the tendency of Nature towards the production of organized bodies, and the facility with which she performs the operation. But I will not stop here. Instead of dividing matter into *organized* and *brute matter*, the general division ought to be into *living* and *dead matter*. That *brute matter* is nothing but matter produced by the *death* of animals and vegetables, might be proved from the enormous quantities of shells, and other relics of living bodies, which constitute the principal parts of stones, marbles, clays, marls, earths, turfs, and other substances that are commonly reckoned *brute matter*, but are, in reality, composed of decayed animals and vegetables. This doctrine will be farther illustrated by the subsequent remarks, which appear to be well founded.

The great facility and activity of Nature in the production of organized bodies, the existence of infinite numbers of organic particles which constitute life, have been already shown. We now proceed to inquire into the principal causes of death and destruction. In general, beings which have a power of converting matter into their own substances, or of assimilating the parts of other beings, are the greatest destroyers. Fire, for example, which converts almost every species of matter into its own substance, is the greatest source of destruction that we are acquainted with. Animals seem to partake of the nature of flame; their internal heat is a species of fire approaching to flame. Accordingly, animals are the greatest destroyers; and they assimilate and convert into their own substance all bodies which can serve them for nourishment. But, though these two causes of destruction be considerable, and their effects tend perpetually to the destruction of organized bodies, the cause of reproduction is infinitely more active and powerful. It even seems to derive, from destruction itself, fresh powers of multiplying; for assimilation, which is one cause of death, is, at the same time, a necessary mean of producing life.

The destruction of organized bodies, as has been remarked, is only a separation of the organic particles of which they are composed. These particles continue separate till they be again united by some active power. But what is this power? It is the power, possessed by animals and vegetables, of assimilating the matter of their food; and is not this the same, or nearly connected with the same power which is the cause of reproduction?

CHAPTER III.

Of Nutrition and Growth.

AN animal body is a kind of internal mould in which the nutritive matter is so assimilated to the whole, that, without changing the order or proportion of the parts, each part receives an augmentation. This increase of bulk has, by some philosophers, been called an expansion or unfolding of the parts; because they fancied they had accounted for the phænomenon, by telling us, that the form of an animal in embryo was the same as at full maturity, and that, therefore, it was easy to conceive how its parts should be proportionally unfolded and augmented by the addition of accessory matter.

But, how can we have a clear idea of this augmentation or expansion, if we consider not the bodies of animals, and each of their parts, as so many internal moulds which receive the accessory matter in the order that results from their position and structure? This expansion cannot be effected solely by an addition to the surfaces, but, on the contrary, by an intus-susception, or by penetrating the whole mass; for the size of the part is augmented proportionally, without changing its form. Hence it is necessary, that the increasing matter must, in some manner or other, intimately penetrate the whole part in all its dimensions: it is equally necessary, that this penetration should be effected in a fixed order and proportion, so that no internal point receive more matter than another; otherwise some parts would be more

quickly unfolded than others, which would entirely change their figure. What can thus regulate the accessory matter, and force it to arrive equally and proportionally to every internal point of the body, if we have not recourse to an internal mould?

The bodies of animals and of vegetables, therefore, consist of internal moulds, which uniformly preserve the same figure. But their masses may receive a proportional increase, by the expansion of the moulds in all their dimensions, both internal and external; and this expansion is effected by an intus-susception of an accessory and foreign matter, which intimately penetrates the whole, and assumes the same form and identity of substance with the matter of the moulds themselves.

But what is the nature of that matter which an animal, or a vegetable, assimilates to its own substance? What bestows on it that force and activity which enables it to penetrate the internal mould? If such a power exists, must it not be similar to that by which the mould itself is capable of being reproduced?

These three questions include the whole subject, and appear to depend on one another; for it is impossible to explain, in a satisfactory manner, the reproduction of animals or vegetables, if we have not a clear idea how the operation of nutrition is performed. Each question, therefore, demands a separate examination, that we may be enabled to compare their results.

The first, which regards the nature and qualities of the nutritive matter, is in part resolved by the preceding reasonings, and shall be clearly unfolded in the subsequent chapters. We shall show, that there are in Nature infinite numbers of living organic particles: that Nature produces them without any expence, because their existence is constant and invariable; that the causes of death disunite these particles only, but do not destroy them. Thus the matter assimilated by an animal or vegetable, is an organic matter of the same nature with that of the animal or vegetable, and, consequently, may augment the size without changing the figure or the qualities of the original moulds; because it has the same qualities and the same form with the matter of which the moulds themselves are composed. Of the quantity of aliment taken by an animal to support its life, and to maintain the vigour of its organs, and of the juices absorbed by the roots and leaves of a plant, a great part is rejected by transpiration, by secretions, and by other excretories; and a small portion only is retained for the nourishment and expansion of the parts. It is extremely probable, that, in the bodies of animals and of vegetables, a separation is made between the *brute* particles of the aliment and the organic; that the former are carried off by the methods just mentioned; that nothing but the organic particles remain; and that they are distributed, by means of some active power, to the different parts, in a proportion so exact, that neither more nor fewer are applied than answer the purposes of nutrition, and of an equal growth and expansion.

As to the second question, What is the nature of that active power, which enables the organic matter to penetrate and combine with the internal mould? It is apparent, from the preceding chapter, that powers exist in Nature, like that of gravity, which affect the most internal parts of matter, without having the smallest relation to its external qualities. These powers, as formerly observed, are beyond the reach of our senses; because their action is exerted upon the intimate structure of bodies. It is evident, therefore, that we can never obtain a clear idea of them, nor of their mode of acting. Their existence, however, is not less certain, than that, by means of them, most natural effects are produced, especially those of nutrition and expansion, which must be owing to a cause that penetrates the most intimate recesses of the original moulds; for, in the same manner as gravity pervades the whole parts of matter, the power which pushes forward or attracts the organic particles of food, penetrates the internal parts of organized bodies; and, as these bodies have a certain form, which we have distinguished by the appellation of *internal moulds*, the organic particles, pushed on by the action of this penetrating force, must enter in an order relative to this form, and consequently cannot alter its figure, but only augment its bulk, and give rise to the growth and expansion of organized bodies: and if, in the organized body, thus expanded, there be some particles similar to the whole, both internally and externally, these parts will become the source of reproduction.

Let us now examine the third question, namely, Is it not by a similar power that the internal mould itself is reproduced? This power appears to be not only similar, but the very same with that which is the cause of expansion and reproduction; for, in an organized and expanded body, nothing farther is necessary for the reproduction of a new body similar to itself, than that it should contain some particle every way similar to the whole. This particle, at its first separation, will not present to our eyes a sensible figure by which we can compare it with the whole body. But, when separated from the body, and put in a situation to receive proper nourishment, this similar particle will begin to expand and to exhibit the form of an entire and independent being, of the same species with that from which it was detached. Thus, a willow or a polypus, as they contain a larger proportion of particles similar to the whole, than most other substances, when cut into any indefinite number of pieces, each segment becomes a new body similar to the parent from which it was separated.

Now, in a body of which all the particles are similar to itself, the organization is the most simple, as has been remarked in the first chapter; for it is only a repetition

of the same form, a congeries of figures, similarly organized. It is for this reason that the most simple bodies, the most imperfect species, are most easily and most abundantly reproduced. But, if an organized body contain only few particles similar to itself, as these alone are capable of a second expansion, its power of reproducing will be both more difficult, and more circumscribed as to the number produced. The organization of bodies of this last kind is also more complex, because it possesses fewer parts which are similar to the whole; and, therefore, the more perfectly a body is organized, its power of reproduction will be proportionally diminished.

In this manner we discover nourishment, growth, and propagation, to be effects of the same cause. Organized bodies are nourished by the particles of aliment which are similar to them; they grow or are expanded by absorbing those organic particles which correspond to their own nature; and they propagate, because they contain some organic particles similar to themselves. It only remains to examine whether these similar organic particles are extracted from the food, or have a primary and independent existence in the bodies themselves. If we suppose the latter, we recur to the infinity of similar parts or germs contained within each other, an hypothesis which we have already shown to be replete with difficulties and absurdities. We must, therefore, maintain, that the similar parts are extracted from the food; and, after what has been said on the subject, we hope to be able to explain the manner of their absorption, and how the more minute organic particles which compose them are united.

We formerly remarked, that the organic parts of food were separated from those which have no analogy to the animal or vegetable, by transpiration and other excretions. The first remain, and serve to expand and nourish the body: but these organic parts must be of very different species; and, as each part of the body receives only a proper number of those which correspond to it, the surplus, it is natural to imagine, will be returned from all parts of the body, and be collected in one or more reservoirs, where they will unite and form small organic bodies similar to the first, and which require nothing but proper circumstances for expanding and becoming new individuals of the same species; for, as all parts of the body send off organic particles similar to those of which themselves are composed, the result of their union must be the production of new organized bodies similar to the original. Hence we may conclude, that this is the reason why organized bodies, during the time of their growth and expansion, are seldom or never capable of reproducing; because the growing parts absorb the whole organic particles presented to them, and no surplus being sent from the different parts of the body, propagation becomes, of course, impracticable.

This account of nutrition and of reproduction, will not, perhaps, be received by those philosophers who admit only a certain number of mechanical principles, and reject every thing as false which depends not upon them; and, as the explication now given of nutrition and reproduction has no connection with any of these principles, they will conclude that it deserves no credit. But I think very differently from these philosophers. In admitting only a few mechanical principles, they consider not how much they contract the bounds of philosophy, and how few phænomena can, by this narrow method of thinking, be fully explored.

The notion of explaining all the appearances in nature upon the principles of mechanism, is, doubtless, a great exertion, and was first attempted by Descartes. But it is, at least, an untenable project; and, though it were otherwise, we are unable to put it in execution. These mechanical principles are, the extension of matter, its impenetrability, its motion, its external figure, its divisibility, the communication of motion by impulse, by the action of springs, &c. These ideas we have acquired by our senses, and we regard them as principles, because they are general and common to all matter. But are we certain that matter possesses no other qualities? Ought we not rather to believe that these qualities, which we assume for principles, are only modes of perception; and that, if the conformation of our senses were different, we would recognize qualities in matter very different from those above enumerated? It is presumptuous to deny every quality to matter but those we are acquainted with. Many general qualities, perhaps, remain to be discovered; and many may exist which will for ever elude human discernment. The cause of impulsion, of cohesion, or of any other mechanical principle, will always continue to be equally inscrutable as that of attraction, or of any other general quality. Hence it may be concluded, that mechanical principles are nothing else than general effects which experience has enabled us to remark in matter; and that, whenever we shall discover, either by reflection, by analogy, or by experience, a new general effect, it will become a new mechanical principle, which may be employed with equal advantage and certainty as any of those that are already known.

The defect of Aristotle's philosophy was the employing particular effects as causes; and that of Descartes consists in the rejection of every cause but a few general effects. To use nothing as causes but general effects, to endeavour to augment the number of these, and to attempt to generalize particular effects, would constitute the most perfect principles of genuine philosophy.

In my theory of expansion and reproduction, I first admit the mechanical principles, then the penetrating force of gravity, and, from analogy and experience, I have concluded the existence of other penetrating forces

peculiar to organized bodies. I have proved by facts, that matter has a strong tendency towards organization; and that there are in nature an infinite number of organic particles. I have, therefore, only generalized particular observations, without advancing any thing contrary to mechanical principles, when that term is used in its proper sense, as denoting the general effects of nature.

CHAPTER IV.

Of the Generation of Animals.

As the organization of man, and of other animals, is the most perfect, and the most complex, the propagation of them is likewise most difficult, and the number of individuals is less abundant. I except here such animals as can be multiplied by a separation of their parts, or without the aid of generation, these having been sufficiently treated of in the preceding chapter.

But how will the theory delivered in the former chapter apply to the generation of men, and other animals, who are distinguished by sexes? We understand, from what has been said, how every individual may reproduce; but we cannot conceive how two individuals, the one a male, and the other a female, should uniformly produce a third.

Before replying to this objection, I must observe, that the writers on this subject have confined their ideas solely to the generation of men and of animals, without attending to the nature of reproduction in general: and as the generation of animals is the most complicated species of reproduction, they have laboured under great disadvantages, not only by attacking the most difficult point, but by leaving themselves no subject of comparison to enable them to illustrate the question. To this circumstance I chiefly attribute the unsuccessfulness of their attempts. But, by the method I have observed, I am persuaded that I shall be able to give a satisfactory explanation of every species of reproduction.

Let the generation of man serve as an example. To begin with infancy:

The expansion and growth of the different parts of man's body being effected by the intimate penetration of organic particles, analogous to each of these parts, all the organic particles, in early life, are absorbed, and entirely employed in unfolding and augmenting his different members. He has, of course, little or no superfluous particles, till his growth be completed. It is for this reason that infants are incapable of propagating. But, when man's body has nearly attained its full size, he requires not the same quantity of organic particles; the surplus is, therefore, sent from all parts into reservoirs destined for their reception. These reservoirs are the testes and seminal vessels. At this very period, when the growth of the body is nearly finished, puberty commences, and every phænomenon attending it discovers a superabundance of nourishment; the voice changes into a deeper tone; the beard begins to appear, and other parts of the body are covered with hair; the parts destined for generation are suddenly expanded; the seminal fluid fills the reservoirs prepared for its reception, and spontaneously escapes from the body during sleep. This superabundance is still more evident in the female: it discovers itself by a periodic evacuation, which begins and terminates with the faculty of propagating; by a quick increase of the breasts; and by a change in the sexual parts, which shall be afterwards explained. (See below the Nat. Hist. of Man, chap. ii.)

I conceive, then, that the organic particles sent from all parts of the body into the testicles and seminal vessels of the male, and into the ovarium of the female, compose the seminal fluid which, in either sex, as formerly observed, is a kind of extract from the several parts of the body. These organic particles, instead of uniting and forming an individual similar to that in whose body they are contained, as happens in vegetables and some imperfect animals, cannot accomplish this end without a mixture of the fluids of both sexes. When this mixture is made, if the organic particles of the male exceed those of the female, the result is a male; and if those of the female abound most, a female is generated. I mean not that the organic particles of the male or of the female could singly produce individuals; a concurrence or union of both is requisite to accomplish this end. Those small moving bodies, called *spermatic animals*, which, by the assistance of the microscope, are seen in the seminal fluid of all male animals, are perhaps organized substances proceeding from the individual which contains them; but, of themselves, they are incapable of expansion, or of becoming animals similar to those in whom they exist. We shall afterwards demonstrate, that there are similar animalcules in the seminal fluids of females, and point out the place where this fluid is to be found.

It is probable, that these organic bodies are only the

first rudiments of an animal, containing nothing but its essential parts. We shall not enter into a detail of proofs on this subject, but content ourselves with remarking, that the organization of these pretended spermatic animals may be very imperfect; or rather, that they are the living organic particles mentioned above, which are common both to vegetables and to animals; or, at most, that they are only the first junction of these particles.

But, to return to our subject. It may be asked, how is it possible that the superfluous organic particles should be detached from all parts of the body, and unite upon the mixture of the male and female fluids? Besides, are we certain that such a mixture takes place? Has it not been maintained, that the female furnishes no fluid of this kind? Is it an established fact, that the male fluid enters the uterus? &c.

To the first question I reply, that, if what I had said concerning the penetration of the internal mould by the organics particle, in growth and nutrition, had been properly understood, it would be easy to conceive, that when these particles are unable to penetrate the parts into which they formerly entered, they must take another route, and, of course, arrive at some other part, as the testicles and seminal vessels. Every attempt to explain the animal œconomy, and the various motions of the human body, by mechanical principles alone, must be vain and ineffectual; for, it is evident, that the circulation of the blood, muscular motion, and other functions of an animated body, cannot be accounted for by impulsion, or by any of the common laws of mechanism. It is equally evident, that growth and reproduction are effects of laws of a different nature. Why, then, do we refuse the existence of penetrating forces which act upon the whole substances of bodies, when we have examples of such powers in gravity, in magnetic attraction, in chemical affinities? since, therefore, we are assured by facts, and by a number of constant and uniform observations, that there are powers in nature which act not by impulsion, why are not these powers ranked among mechanical principles? Why do we reject them in the explanation of effects which they are known to produce? Why are we desirous of employing the power of compulsion only? Is not this equally absurd as to judge of painting by the touch; to explain the phænomena which belong to the mass by those that relate only to the surface; or to use one sense in place of another? It is limiting the reasoning faculty to a small number of mechanical principles, which are by no means sufficient to explain the various effects of Nature.

But, if these penetrating forces be admitted, is it not natural to imagine, that those particles which are most analogous to one another will unite in the most intimate manner; that each part of the body will appropriate those which are most agreeable to its nature; and that the whole superfluous particles will form a seminal fluid, which shall contain all the organic particles necessary for forming a small organized body, similar in every respect to that from which the fluid is extracted? May not a force similar to that which is the cause of growth, be sufficient to collect the superfluous organic particles, and bestow on them the figure of the body from which they proceed?

That our food contains an immense number of organic particles, requires no formal proof; since we are solely nourished by animals and vegetables, which are organized substances. In the stomach and intestines, the gross parts of the aliment are separated and rejected by the excretories. The chyle, which is a purer part of the aliment, is absorbed by the lacteal vessels; from thence it is carried into the mass of blood, and, in the course of circulation, it is more and more refined, the unorganic and useless particles being thrown out by transpiration and other secretions: but the organic particles are retained, because they are analogous to the blood, and are attracted by it. Hence, as the whole mass of blood passes several times through the body, during the course of this perpetual circulation, I suppose, that each particular part attracts those particles which are most analogous to it, and allows the rest to move on. In this manner all the parts are nourished and unfolded, not, as is commonly imagined, by a simple addition of matter to their surfaces, but by an intimate penetration of substance, effected by a force which acts equally upon every point of the whole mass; and, after the different parts have acquired their utmost growth, and are fully impregnated with similar organic particles, as their substance becomes then more dense and solid, I imagine that they lose their faculty of attracting and receiving the particles presented to them. But, as the particles continue to be carried round in the course of the circulation, and are no longer absorbed in such quantities as formerly, they must, of necessity, be deposited in some particular reservoir, such as the testicles and seminal vessels. When this fluid extract of the male is mixed with that of the female, the particles which are most analogous to each other, being actuated by a penetrating force, unite and form a small organized body, similar to the one or the other sex; and this body, when once formed, requires only an expansion of its parts, an operation which is performed in the womb of the mother.

We shall now consider the second question, namely, Whether the female has a seminal fluid similar to that of the male? In the *first* place, though such a fluid exists in females, the mode of emission is very different from that of the male, being generally confined within the body. (Quod intra se semen jacit, fœmina vocatur; quod in hac jacit, mas; *Aristot. de Animalibus*, *art.* 18.)

The ancients were so confident of the existence of a female fluid, that they distinguished the two sexes by their different modes of emission. But those physicians who attempt to explain generation by eggs, or by spermatic animalcules, insist, that females have no peculiar fluid; that the mucus issuing from the parts has been mistaken for a seminal fluid; and that the opinion of the ancients on this subject is destitute of foundation. This fluid, however, does exist; and the doubts concerning it have arisen solely from attachment to systems, and from the difficulty of discovering its reservoir. The fluid which is separated from the glands about the neck and orifice of the uterus, has no visible reservoir; and, as it flows out of the body, it is natural to think that it is not the prolific fluid, because it cannot co-operate in the formation of the fœtus, which is performed within the uterus. The reservoir for the prolific fluid of the female, therefore, must be situated in a different part: it even flows abundantly; though, like that of the male, a small quantity is sufficient to produce a fœtus. If a little of the male fluid enters the uterus, either by its orifice or by absorption, and meets with the smallest drop of the female fluid, it is sufficient for the purpose of propagation. Thus, neither the observations of some anatomists, who maintain that the seminal fluid of the male can have no admission into the uterus, nor the opposite opinion maintained by their antagonists, have any influence upon the theory we are endeavouring to establish. But the discussion of these points we leave to a future opportunity.

Having obviated such objections as might be made, let us attend to the evidences which concur in supporting our hypothesis. The first arises from the analogy between growth and reproduction. It is impossible to give a satisfactory account of growth or expansion, without having recourse to those penetrating forces, those affinities or attractions which we employed in explaining the formation of the small organic bodies, that are similar to the large bodies which contain them. A second analogy is derived from this circumstance, that both nutrition and reproduction proceed, not only from the same efficient, but from the same material cause, namely, the organic particles of food; and what proves the surplus of the nutritive particles to be the cause of reproduction, is, that the body is not in a condition to propagate till its growth be finished: of this we have daily examples, in dogs and other animals, who follow, more closely than we do, the laws of Nature: they have no inclination to propagate till they have nearly attained their full growth; and by this we know whether the growth of a dog be finished; for he seldom grows after being in a condition to generate.

Another proof that the seminal fluid is formed of the surplus of the nutritive particles, arises from the condition of eunuchs and other mutilated animals: in this unnatural state, animals grow fatter than those who retain all their parts. The superabundance of nutriment, having no organs for its evacuation, changes the whole habit of their bodies. The knees and haunches of eunuchs grow uncommonly large. The reason is evident. After their bodies have acquired the common size, if the superfluous organic particles found an issue, as in other men, the growth would proceed no farther. But, as they want organs for emitting the seminal fluid, which is nothing but the superfluous nutritive particles, it remains in the body, and has a constant tendency to expand the parts beyond their natural size. Now, bones, it is well known, grow or extend by their extremities, which are soft and spongy, and, when they have once acquired solidity, they are incapable of farther extension: hence the superfluous organic particles can only enlarge the spongy extremities of bones; and this is the reason why the haunches, knees, &c. of eunuchs augment to a disproportioned bulk.

But the strongest proof of the truth of our present doctrine arises from the resemblance of children to their parents. Sons, in general, resemble their fathers more than their mothers, and daughters have a greater resemblance to their mothers than their fathers; because, with regard to the general habit of body, a man resembles a man more than a woman, and a woman resembles a woman more than a man. But, as to particular features or habits, children sometimes resemble the father, sometimes the mother, and sometimes both. A child, for example, will have the eyes of the father, and the mouth of the mother, or the colour of the mother and the stature of the father. Of such phænomena it is impossible to give any explication, unless we admit that both parents have contributed to the formation of the child, and, consequently, that there has been a mixture of two seminal fluids.

These resemblances long embarrassed me, and, till I had maturely considered the subject of generation, led me into many errors and prejudices: and it was not without much thought, a minute examination of a great number of families, and a multiplicity of evidence, that I could prevail on myself to alter my former opinion, and to embrace what I now believe to be truth. But the objects which might occur concerning mulattoes, mongrels, mules, and particular parental resemblances, instead of opposing my theory, I despair not of being able to shew that they bestow on it an additional strength.

In youth, the seminal fluid is less copious, but more stimulating. Its quantity continues to augment till a certain age; because, in proportion as we approach that age, the parts of the body become more solid, admit fewer nutritive particles, send back more of them to the common reservoirs, and, of course, augment the quantity of the seminal fluid. Thus, if the external organs have

not been used, middle-aged men, or even old men, procreate with more ease than young men. This is evidently the case with the vegetable tribes: a tree, the older it is, produces the greater quantity of fruit.

Young people, who, by forced irritations, determine an unnatural quantity of this fluid into the reservoirs prepared for its reception, immediately cease to grow, lose their flesh, and at last fall into consumptions. The reason is apparent; they lose by premature and too frequent evacuations, the very substance which nature intended for the nourishment and growth of their bodies.

Men who are thin, but not emaciated, and those who are plump, but not fat, are the most vigorous. Whenever the superabundant nutritive particles begin to form fat, it is always at the expence of the seminal fluid and other generative powers. When the growth of the different parts of the body is complete, when the bones have acquired full solidity, when the cartilages begin to ossify, and, lastly, when the parts almost refuse the admission of nutritive particles, then the fat augments considerably, and the quantity of seminal fluid diminishes; because the nutritive particles, instead of being sent back to the reservoirs, are arrested in every part of the body.

The quantity of seminal fluid not only increases till we arrive at a certain age, but it becomes more thick. It contains, in the same bounds, a greater quantity of matter. Its specific gravity is nearly double that of the blood; and, of course, it is heavier than any other animal fluid.

To a man in health, an evacuation of this fluid whets the appetite: he soon finds the necessity of repairing the loss by fresh nourishment. Hence we may conclude, that abstinence and hunger are the most effectual checks to luxury of every kind.

Many other remarks might be made on this subject, which must be deferred till we come to treat of the history of man. We shall, therefore, conclude with a few observations. Most animals discover no inclination for the sexes till their growth be nearly finished. Those which have but one season in the year, have no seminal fluid, except at that time. Mr. Needham not only saw this liquor forming in the milt of the *Calmar*, but likewise the spermatic animals, and the milt itself, which have no existence till the month of October, when this fish spawns on the coasts of Portugal, where Needham made the observation. After the spawning time is over, the seminal liquor, the spermatic animals, and the milt, dry up and totally disappear; till the same season returns next year, when the superfluous nutritive particles renew the milt as formerly. The history of the deer will furnish us with an opportunity of remarking the various effects of rutting, the most conspicuous of which is the extenuation of the animal; and, in those species of animals whose rutting and spawning happens but once in a year, the extenuation of their bodies is proportionally great.

As women are smaller and weaker than men, as their constitutions are more delicate, and, as they take less food, it is natural to think that their superfluous organic particles should also be less abundant: of course, their seminal fluid will be weaker and smaller in quantity than that of men; and, since the fluid of females containe fewer organic particles, must not a greater number of males than of females result from a mixture of these two fluids? This is really the case; and to account for it has hitherto been deemed impossible. The number of males born exceeds that of females about a sixteenth part; and we shall afterwards see that the same effect is produced by the same cause in all the different species of animals.

CHAPTER V.

Examination of the different Systems of Generation.

THE great philosopher Aristotle has treated the subject of generation in the most extensive manner. He distinguishes animals into three classes: 1. Those that have blood, and, with few exceptions, propagate by copulation; 2. Those that have no blood, and, being hermaphrodites, produce of themselves without copulation; and, 3. Those that proceed from putrefaction, and have no parents of any kind. I shall first remark, that this division is exceedingly improper: though it be true, that animals having blood are distinguished into male and female, it is by no means equally true, that bloodless animals are, for the most part, hermaphrodites. For the only hermaphrodites we know, are land-snails and worms; but we are uncertain whether all shell-animals, and all those which have no blood, be also hermaphrodites. This must be learned from the particular histories of these animals.

And, with regard to those which are alledged to proceed from putrefaction, as Aristotle gives no enumeration of them, many objections occur; for most species which the ancients believed to proceed from putrefaction, have, by the moderns, been discovered to proceed from eggs.

Aristotle makes a second division of animals, namely, into those which have the faculty of progressive motion, and those which have no such faculty. All animals who move, and have blood, are distinguished by sexes; but those which, like oysters, adhere to one place, or hardly move at all, have no sexes, and, in this respect, resemble plants; and it is only, he observes, from difference in bulk that they have been distinguished into male and female. It must be acknowledged, that we are still uncertain whether shell-animals have sexes: among oysters, some individuals are fertile, and others not. The fertile individuals are distinguished by a delicate edging or border which surround their bodies, and they are called males. Our observations on this subject are extremely limited.

But to proceed. The male, according to Aristotle, contains the principle of motion, and the female the material part of generation. The organs destined for this purpose are different in different animals. Of these the testicles are the chief in males, and the uterus in females. Quadrupeds, birds, and cetaceous animals, have testicles; fishes and serpents are deprived of them; but they have two canals for the reception and maturation of the semen: these parts, so essential to generation, are always double both in males and females; and, in the male, they retard the motion of that part of the blood which goes to the formation of semen. This he proves from the example of birds whose testicles swell considerably during the season of their amours, but afterwards diminish so much, that they can hardly be discovered.

All quadrupeds covered with hair, and the cetaceous fishes, as whales and dolphins, are viviparous. But vipers and cartilaginous animals are not properly viviparous; because they produce an egg within their own bodies, previous to the exclusion of the live animal. Oviparous animals are of two kinds; those which produce perfect eggs, as birds, lizards, turtles, &c. and those which produce imperfect eggs, as fishes, whose eggs augment and come to perfection after they have been deposited in the water by the female: and in every species of oviparous animals, except birds, the females are larger than the males, as in fishes, lizards, &c.

After remarking these general varieties in the animal kingdom, Aristotle begins with examining the opinion of the ancient philosophers, that the semen, both of the male and female, was extracted from all parts of the body; and he dissents from this opinion; because, says he, though children often resemble both father and mother, they sometimes also resemble their grandfathers. Besides, they resemble their fathers and mothers in the voice, in the hair, in the nails, and in the gait and manner of walking. Now, he proceeds, it is impossible for the semen to come from the hair, from the voice, from the nails, or from any external quality, as that of the mode of walking. Infants, therefore, resemble not their parents because the semen proceeds from all parts of the body, but for other reasons. I will not expose the weakness of these arguments, but shall only remark that this great man appears to have been anxious to differ from the sentiments of former philosophers. And I am persuaded, that, whoever peruses his treatise on generation, will discover that a strong passion for establishing a system different from that of the ancients, obliges him uniformly to prefer arguments of little probability, to the force of proofs, when they stand in opposition to the general principles of his philosophy.

Thus have I given a short view of what Aristotle has delivered on the subject of generation, and shall leave the reader to consider whether any system of the ancients be more obscure, or more absurd, than that which he has endeavoured to establish. His system, however, has been adopted by most men of learning. Harvey has borrowed many of Aristotle's notions; but he has also adopted some of his own, which are by no means better founded. It is not surprising that Aristotle's theory of generation, which was a result of his system of philosophy, where form and matter are the great principles, where vegetable and sensitive souls are the agents of nature, and where final causes are real objects, should have been received in the schools. But it is not a little astonishing to see a physician and an acute observer, like Harvey, carried down the stream, while, at the same time, most philosophers followed the sentiment of Hippocrates and Galen, of which we shall afterwards take notice.

We mean not to convey a disadvantageous idea of Aristotle by the account we have given of his theory of generation. We might with equal propriety judge of Descartes by his Treatise on Man. What these two philosophers have remarked concerning the formation of the fœtus should rather be considered in the light of detached observations, or as consequences which each of them drew from their principles of philosophy than as complete systems. Aristotle admits, with Plato, final and efficient causes. The latter are the sensitive and vegetable souls, that give form to matter, which, in itself, is only a *capacity* of receiving forms: and as, in generation, the female furnishes the greatest quantity of matter, and as it was repugnant to his system of final causes, that any effect should be produced by two causes, when one was sufficient for the purpose, he concludes, that the woman alone contains the matter necessary for procreation. Again, another of his principles is, that matter, in itself, has no form, and that *form* is a being distinct from matter; he therefore maintains, that the

male furnishes the form, and, of course, that he contributes nothing *material*.

Descartes, on the contrary, admitted into his philosophy a few mechanical principles only. By these he attempted to explain the formation of the fœtus; and he imagined that he understood, and was able to communicate to others, the manner in which a living organized body could be formed by the laws of motion alone. The principles he employed were different from those of Aristotle. But both of them, instead of directing their inquiries to the subject itself, in place of examining it with impartiality, considered it only in relation to their philosophic principles, which could never be applied with success to the nature of generation, because it depends, as has been already shown, upon very different principles. Descartes, however, admits the existence and necessary concurrence of the seminal fluids of both sexes. He allows that both furnish something material for the purposes of generation; and that the fermentation occasioned by a mixture of the two fluids, is the cause of the formation of the fœtus.

Hippocrates, who lived about five or six hundred years before Aristotle, taught an opinion, which was adopted by Galen, and by most physicians, for many ages. He maintained the existence of a female fluid; and even that both male and female had two fluids, the one strong and active, the other weaker and more sluggish. A concurrence of the two stronger fluids produced a male child, and, of the two weaker, a female. Thus, according to Hippocrates, there exist two kinds of seminal fluids both in the male and in the female. This notion he supports in the following manner: several women who produced girls only by their first husband, have had boys by their second; and the same thing has often happened to men who have had two wives. Supposing this to be fact, it admits of an easy explanation, without having recourse to two different fluids peculiar to each sex; for the women who had girls only by the first husband, and boys by the second, furnished a greater quantity of particles proper for generation during the first, than the second marriage; or the second husband furnished a greater quantity of generating particles during the time of the second marriage, than the first. If, at the moment of conception, the organic particles of the male are more abundant than those of the female, a male child is the result; and, when the organic particles of the female most abound, a female child is the consequence: it is not, therefore, surprising, that the husband should be foiled with some women, and have the superiority over others.

Let us now attend to his account of the formation of the fœtus. The seminal fluids first mix in the uterus, and gradually thicken by the heat of the mother. The mixture extracts the spirit of heat, and, when too warm, part of the heat escapes into the air. But a cold spirit is likewise conveyed to it by the respiration of the mother; thus a cold and a hot spirit alternately enter the mixture, give life to it, and cover its surface with a pellicle, which assumes a round figure, because the spirits acting in the centre, expand the matter equally on all sides. I have seen, says this great physician, a fœtus of six day old: it was a ball of liquor inclosed in a pellicle. The liquor was reddish; and the pellicle was interspersed with red and colourless vessels. In the middle of it there was a small eminence, which I apprehended to be the umbilical vessels, by which the fœtus receives nourishment and the spirit of respiration from the mother. A second covering or pellicle gradually forms above the first. Abundance of nourishment is furnished by the menstrual blood, which coagulates by degrees, and is converted into flesh. This flesh gradually articulates as it grows; and the spirit bestows upon it this form. Every part assumes its proper place; the solid particles unite; the moist particles associate by themselves; every thing searches for what is analogous to it; and, in fine, the fœtus, by these causes and means, is completely formed.

This system is more rational, and less obscure than that of Aristotle; because Hippocrates endeavours to explain every particular appearance, and borrows one general principle only from the philosophy of his times, namely, that heat and cold produce spirits, and that these spirits have the power of arranging and of bestowing figure upon matter. He treats his subject more like a physician than a philosopher; but Aristotle explains the phænomena of generation more as a metaphysician than a naturalist. It is for this reason that the errors of Hippocrates are particular and less apparent, and that those of Aristotle are general and evident.

These two great men have each had their followers. Almost all the philosophers of the schools adopted Aristotle's theory of generation, while most physicians adhered to the theory of Hippocrates; and, in this manner, 17 or 18 centuries passed without the appearance of any thing new upon this mysterious subject.

At last, upon the revival of literature, some anatomists began to investigate the nature of generation; and Fabricius ab Aquapendente was the first who thought of making a course of experiments upon the impregnation and expansion of the eggs of fowls, the substance of which we shall lay before the reader.

He distinguishes the matrix of a hen into two parts, the one superior, and the other inferior. The superior part, which he calls the ovarium, is an assemblage of a great number of small yellow eggs, of a round figure, the sizes of which vary from that of a mustard seed to that of a walnut. These eggs are attached to one another by foot-stalks, and the whole somewhat resembles a bunch of grapes. The smallest eggs are white, and they turn yellower in proportion as they increase.

Having examined those yellow eggs immediately after a communication with the male, he could perceive no sensible difference; he saw none of the male semen in any part of the eggs: he therefore concluded, that the whole eggs, and even the ovarium itself, were rendered fertile by a subtile spirit which issues from the male semen; and, he adds, that, in order to prevent the escape of this fecundating spirit, Nature has placed, at the external orifice of the vagina of birds, a membranous valve which permits the seminal spirit to enter freely into the vagina, but prevents its return.

When an egg is detached from the common pellicle, it gradually descends, through a winding canal, into an inferior part of the matrix. This canal is filled with a liquor very similar to the white of an egg. It is here that the egg receives its white liquor, the membrane in which it is inclosed, the two cords *(chalazæ)* that run through the white, and join it to the yolk, and the shell which is suddenly formed immediately before exclusion. These cords, according to our author, are the part of the egg which is impregnated by the seminal spirit of the male; and it is here also that the rudiments of the fœtus first appear. The egg is not only the true matrix, or the place where the chick is formed, but the whole business of generation depends upon it. The egg is the great agent in generation; it furnishes both the matter and the organs. The substance of the cords is the matter of which the chick is formed; the white and the yolk afford it nourishment; and the seminal spirit of the male is the efficient cause. This spirit communicates to the cords, first, an alterant quality, then a forming quality, and, lastly, a power of augmenting, &c.

These observations of Fabricius, it is apparent, lead not to any clear idea of generation. At the same time that this anatomist was making his experiments, which was about the middle of the sixteenth century, the famous Aldrovandus made some remarks upon eggs. But, as Harvey properly observes of him, he followed more the authority of Aristotle than of experiment. The description he gives of the chick in the egg is by no means exact. Volcher Coiter, one of his pupils, succeeded better than his master; this writer, together with Parisanus, a Venetian physician, have each given descriptions of the chick in the egg, which Harvey prefers to all the others.

This celebrated anatomist, who first discovered the circulation of the blood, has given an excellent treatise on generation. He flourished about the middle of last century, and was physician to Charles I. of England. As he was obliged to follow this unhappy Prince during his misfortunes, he lost, among other papers, what he had written concerning the generation of insects; and it appears, that he composed from memory his treatise on the generation of birds, and of quadrupeds. I shall give a short view of his remarks, of his experiments, and of his theory.

Harvey alledges, that men, and all other animals proceed from eggs; that, in vivaparous animals, the first produce of conception is a kind of egg; and that the only difference between the vivaparous and oviparous is, that, in the former, the fœtuses begin to exist, increase, and acquire their full growth in the uterus; but that, in the oviparous animals, the rudiments of the fœtuses begin to exist in the body of the mother, where they are in the form of eggs; and it is only after their exclusion that they become real fœtuses. And it deserves to be remarked, says he, that, in oviparous animals, some retain their eggs till they be perfect, as birds, serpents, and oviparous quadrupeds; and that others exclude their eggs before they are perfect, as fishes, crustaceous and testaceous animals. The eggs laid by these creatures are only the rudiments of eggs, which afterwards acquire membranes and a white, and attract nourishment from the matter with which they are surrounded. There are even, he adds, insects, caterpillars, for example, which are only imperfect eggs; they search for their nourishment, and, at the end of a certain time, they arrive at the state of a chrysalis, which is a perfect egg. Another difference may still be remarked in oviparous animals: the eggs of hens, and other birds, are of all different sizes; but those of fishes, frogs, &c. which lay them before they are perfect, are all of the same size. He indeed observes, that, in pigeons, which lay two eggs, all the small eggs that remain in the ovarium are of the same bulk; and that the two only which are next to be excluded exceed the size of the rest. The same thing happens in cartilaginous fishes, as in the ray, which only brings to maturity two eggs at a time, all the rest being of different sizes, like those of the hen.

He next describes anatomically the parts necessary to generation; and remarks, that the situation of the anus and vulva in birds differ from those of all other animals, the anus being placed before, and the vulva behind. And, with regard to the cock and all small birds, he alledges, that they have no proper penis, and that they generate by rubbing, without any intromission. But male-ducks, geese, and ostriches, are amply provided with this instrument.

Hens produce eggs without the intervention of the cock; but, though perfect, they are fewer in number, and unfertile. He credits not the common opinion, that a few days intercourse with the cock are sufficient to impregnate all the eggs which a hen will lay during the year; but he acknowledges, that he separated a hen from the cock for 20 days, and that all the eggs she laid were fecundated. As long as the egg remains attached to the ovarium, it is nourished by the vessels of the common pedicle; but, when it separates from this pedicle, it receives the white liquor and the shell

from the matter with which the canal of the uterus is filled.

The two cords (*chalazæ*) which Aquapendente considered to be the germ, or part produced by the male semen, are found in unimpregnated, as well as impregnated eggs; and Harvey properly observes, that these parts neither proceed from the male, nor receive the impregnation. The part of the egg which receives the impregnation is a small white circle situated upon the membrane that covers the yolk, and has the appearance of a cicatrice about the size of a lentil. Harvey likewise remarks, that this cicatrice is found in all eggs, whether they be fecundated or not; and that those are deceived who imagine it to be produced by the seed of the male. It is of the same size and form in fresh eggs, as in those which have been long kept. But, as soon as the process of hatching is begun, whether by means of artificial heat, or by the heat of the hen, this small mark or cicatrice gradually augments and dilates like the pupil of the eye. This is the first change, and it is visible after a few hours incubation.

When the egg has been heated for 24 hours, the yolk, which was formerly in the centre, rises towards the cavity at the thick end of the egg. This cavity continues to enlarge by the evaporation of the more fluid part of the white; and the heaviest part of the white falls down to the small end. The cicatrice or speck on the membrane of the yolk, is elevated along with it, and applies itself to the membrane which lines the cavity at the thick end. This speck is now as large as a pea; and a white point is distinguishable in the middle of it, with several circles, of which this point appears to be the common centre.

At the end of the second day, these circles are larger and more conspicuous, and they divide the speck sometimes into two, and sometimes into three parts, of different colours. A small external protuberance likewise appears, which nearly resembles a little eye, with a white point or cataract on the pupil. Between the circles, a liquor, as transparent as crystal, is contained by means of a very thin membrane. The speck, which is now become a kind of bubble, or liquid globe, appears as if it were situated in the white, rather than on the membrane of the yolk. On the third day the transparent liquor, as well as the membrane in which it is inclosed, is considerably augmented. On the fourth, a small line of blood, of a purple colour, appears on the circumference of the bubble; and, at a little distance from the centre, we perceive a dot or point, of a bloody colour, which beats like a heart. It is visible at every diastole, and disappears during the systole. From this animated point two small blood-vessels issue, and terminate in the membrane which contains the transparent crystalline liquor. These blood-vessels set off from the same place, nearly in the same manner as the roots of a tree set off from the trunk; and it is in the angle which these roots form with the trunk, and in the middle of the liquor, that the animated point is situated.

Towards the end of the fourth or beginning of the fifth day, the animated point is so much enlarged, that it has the appearance of a small bladder filled with blood; and, by its contractions and dilatations, it is alternately filled and emptied. On the same day we distinctly perceive, that this bladder is divided into two parts, each of which dilates and contracts in the same manner. Round the shortest of the blood-vessels described above, a kind of cloud appears, which, though transparent, obscures the view of the vessel. Every hour this cloud becomes thicker; it attaches itself to the root of the blood-vessel, and seems to depend from it like a small globe. This globe extends, and appears to divide into three parts, one of which is globular, and larger than the other two; and here we perceive the rudiments of two eyes, and of the whole head: and, at the end of the fifth day, we see, in the remainder of this lengthened globe, the beginnings of the vertebræ.

On the sixth day, the parts of the head are more apparent. We distinguish the coats of the eyes, the thighs, and wings; and then the liver, the lungs, and the beak. The fœtus now begins to move and to stretch out its head, though nothing but the viscera are yet formed; for the thorax, the abdomen, and all the external coverings of the fore part of the body, are still wanting. At the end of this day, or the beginning of the seventh, the claws begin to be visible; the chick opens and moves its beak; and the anterior parts of the body begin to cover the viscera. On the seventh day, the chick is entirely formed; and, from this time till it issues from the egg, nothing happens but an expansion of all the parts it acquired during the first seven days. The feathers appear on the 14th or 15th day; and, on the 21st, the chick escapes from the egg, by breaking the shell with its bill.

These experiments of Harvey appear to have been made with the greatest exactness and fidelity. We shall, afterwards, however, demonstrate their imperfection, and that the author has probably fallen into the common error of making experiments, with a view to establish his favourite hypothesis, that the first animated point which appeared was the heart. But, before proceeding to this object, it is proper to give an account of his other experiments.

Every body knows the numerous experiments made by Harvey upon female deer. They receive the male about the middle of September. A few days after copulation, the horns [two fleshy processes, one of which issues from each side of the *fundus uteri*, in the form of little horns, and are remarkably large in some quadrupeds,]

of the uterus appear to be thicker and more fleshy than usual: they are, at the same time, more lax and flabby; and, in each of their cavities, five carunculæ, or soft warts, appear. About the 26th or 28th of September, the uterus is still thicker; the five carunculæ are swelled nearly to the size and form of a nurse's nipple. On opening them with a scalpel, they appear to be filled with an infinite number of white points. Harvey pretends to have remarked, that neither now, nor immediately after copulation, had the ovarium suffered any change; and that he never could discover, after repeated trials, the least drop of male semen in the uterus.

Towards the end of October, or the beginning of November, when the females were separated from the males, the thickness of the horns began to diminish; the internal surfaces of their cavities were swelled, and seemed to be glued together. The carunculæ still remained; and the whole resembled the substance of the brain, being so soft that it could not be touched. Harvey tells us, that, on the 13th or 14th of November, he perceived filaments, like those of a spider's web, which traversed the cavities of the horns, and even that of the uterus itself. These filaments arose from the superior angle of the horns, and, by their number, formed a kind of membrane or empty coat. A day or two afterwards, this coat or sac was filled with a white, aqueous, viscid matter, and adhered to the uterus by means of a kind of mucilage; and the adhesion was most sensible at the superior part of the uterus, where the rudiments of the placenta began then to appear. In the third month, this sac contained an embryo of two fingers breadth in length, and also an internal sac, called the amnios, inclosing a transparent crystalline liquor, in which the fœtus swam. The fœtus, at first, was only an animated point, like what appeared in the hen's egg. Every thing now proceeded and terminated in the same manner as described with regard to the chick, with this only difference, that the eyes of the chick appeared much sooner than those of the deer. The animated point was visible about the 19th or 20th of November. A day or two afterwards, the oblong body, which contained the rudiments of the fœtus, made its appearance. In six or seven days more, the fœtus was so completely formed, that all its members, and even its sex, were distinguishable. But the heart and viscera were still bare; and it was not till a day or two after, that they were covered with the integuments of the abdomen and thorax. This is the last work, the slating of the edifice.

From these experiments upon hens and deer, Harvey concludes, that all female animals have eggs; that, in these eggs a separation of a transparent crystalline liquor, contained in a sac (*amnios*) takes place, and that another external sac (*chorion*) incloses the whole liquors of the egg; that the first thing which appears in the crystalline liquor is an animated sanguineous point; and finally, that the formation of viviparous animals is effected in the same manner as that of the oviparous. The following is the account which he gives of the generation of both.

Generation, he observes, is an operation of the uterus alone; for not a drop of the male semen ever enters it. The uterus conceives by a kind of contagion, communicated to it by the semen of the male nearly in the same manner as the load-stone communicates a magnetic virtue to iron. This male contagion acts not only on the uterus, but on the whole body of the female, which is entirely fecundated, though the uterus alone possesses the faculty of conception, in the same manner as the brain has the sole power of conceiving ideas. The ideas conceived by the brain are similar to the images of the objects transmitted to it by the senses; and the fœtus, which may be regarded as the idea of the uterus, is similar to that by which it is produced. This is the reason why children resemble their fathers, &c.

I will follow the system of our anatomist no farther. What has been said is sufficient to enable the reader to form a judgment. But we have remarks of importance to make concerning his experiments. He has represented them in a manner the most plausible and insinuating. He appears to have repeated them often, and to have taken every necessary precaution to avoid fallacy and deception; and of course we are led to think that he has seen every thing which possibly could be discovered. Uncertainty and obscurity, however, are perceptible in his descriptions. His observations are related from memory; and he seems, though he often maintains the contrary, to have made Aristotle, more than experience, his guide; for he has seen every thing in eggs.

Harvey, because Aristotle says that the yolk rises to the small end of the egg, concludes that he had seen nothing himself, but that he had received his information from some other pretty accurate observer. In this accusation, Harvey evidently injures Aristotle; for the rising of the yolk to either end, depends solely upon its position during the time of incubation; for the yolk, being lighter than the white, uniformly mounts to the top, whether the large or the small end of the egg be uppermost. This observation we owe to William Langley, a physician in Dordrecht, who made experiments on the hatching of eggs in the year 1655, about 20 years before Harvey's time.

But, to return to the passage we have quoted. It is apparent, that the crystalline liquor, the animated point, the two circles, the two blood-vessels, &c. are described by Aristotle in the same manner as they were seen by Harvey. This anatomist maintains, that the animated point is the heart, that the heart is the first part of the fœtus which is formed, and that the viscera and other members succeed. All these circumstances have been

mentioned by Aristotle, and seen by Harvey; and yet that the heart is first formed is by no means consonant to truth. To be assured of this fact, we have only to repeat the same experiments, or to read with attention those of Malpighius, which were made about 50 years after the trials of Harvey.

Malpighius carefully examined the cicatrice, which is the essential part of the egg; he found that it was large in impregnated eggs, and small in those which had received no impregnation; and he discovered, that, in eggs which had never been sat upon by the hen, the white point, mentioned by Harvey as the first part that becomes animated, is a small purse or bubble swimming in the liquor bounded by the first circle; and that the embryo is visible in the centre of this purse. The membrane of the purse, which is the amnios, being exceedingly thin and transparent, allowed him to see the fœtus distinctly. Malpighius, from this first observation, concludes with propriety, that the fœtus exists in the egg before incubation, and that the rudiments of the embryo are even then deeply rooted. It is unnecessary to mention how much this experiment differs from the opinion of Harvey; for he had observed nothing formed during the two first days of incubation; and, in his estimation, the first vestige of a fœtus is the animated point, which appears not till the third day. But Malpighius discovered that the rudiments of the whole fœtus exist before incubation is commenced.

After ascertaining this important fact, Malpighius proceeded to examine the cicatrice of unimpregnated eggs, which, as formerly remarked, is smaller than in those that have received an impregnation. Its margin is often irregular, and its texture sometimes differs in different eggs. Near its centre, in place of a bubble including the fœtus, there is a globular mole or unorganized mass, which, when opened, presents nothing like regularity or arrangement of parts: it has only some appendages filled with a thick but transparent liquor; and this unformed mass is surrounded and enveloped in several concentric circles.

After six hours incubation, the cicatrice is considerably enlarged; and, in its centre, a bubble or globule formed by the amnios is easily distinguishable. This globule is filled with a fluid, in the middle of which the head and backbone of the chick visibly appear. Six hours after, every thing is enlarged, and, of course, more apparent to the eye. In six hours more, that is, 18 hours after the commencement of incubation, the head is larger, and the spine is lengthened; and, at the end of 24 hours, the head of the chick appears in a bended posture, and the spine is of a whitish colour. The vertebræ are ranged on each side of the spine, like small globules; and, nearly at the same time, the wings begin to sprout, and the head, neck, and breast, are lengthened. At the end of 30 hours, nothing new appears; but all the parts are enlarged, and especially the amnios. Round this membrane may be remarked the umbilical vessels, which are of a dark colour. In 38 hours, the chick has acquired more strength; its head is very large, and three vesicles appear in it surrounded with membranes, which likewise include the spine of the back; through which, however, the vertebræ are still visible. At the end of 40 hours, it was admirable to observe, continues our author, the chick living in the centre of the liquor of the amnios. The backbone was increased, the head was bended, the vesicles of the brain were less bare, the rudiments of the eyes appeared, the heart beat, and the blood circulated. Here Malpighius describes vessels and the circulation of the blood; and he thought, with reason, that, though the heart did not beat till 38 or 40 hours after incubation was begun, it nevertheless existed before, as well as the other parts of the chick. But, on examining the heart in a dark chamber, he observed nothing like luminous sparks issuing from it, as Harvey seems to insinuate.

At the end of the second day, the fœtus appeared swimming in the liquor of the amnios. The head, which seemed to be composed of vesicles, was bended; the backbone and vertebræ were lengthened; the heart, which hung out of the breast, beat three times successively, because the fluid it contains is pushed from the auricle into the ventricles, from the ventricles into the arteries, and, lastly, into the umbilical vessels. He remarks, that, having separated the chick from the white of the egg, the motion of the heart continued for a whole day. In 14 hours more, or 62 hours from the beginning of incubation, the chick, though stronger, remained still with its head bended in the liquor of the amnios: veins and arteries were perceived in the brain; and the lineaments of the eyes, and of the spinal marrow, appeared. At the end of three days, the body of the chick was crooked. Beside the two eyes, five vesicles filled with liquor appeared in the head; the rudiments of the thighs and of the wings were discernible; the body began to take on flesh; and the pupils of the eyes, and likewise the crystalline and vitreous humours, were distinguishable. At the termination of the fourth day, the vesicles of the brain were nearer each other; the processes of the vertebræ were longer; the wings and thighs had become stronger, in proportion as they grew longer; the whole body was covered with an unctuous flesh; the umbilical vessels had pierced through the abdomen; and the heart was concealed within the breast, which was now shut up by a thin membrane. On the fifth, and at the end of the sixth day, the vesicles of the brain began to be covered; the spinal marrow, which was now more solid, was divided into two parts, and advanced along the trunk; the thighs and wings were longer, and the wings were unfolded; the abdomen was shut and tumified; the liver was distinctly visible, and it was of a dark colour; the two ventricles of the heart beat; the

body of the chick was covered with skin; and the points of the feathers began to appear. On the seventh day, the head was very large; the brain was covered with its membranes; the beak appeared between the two eyes; the wings, the thighs, and the legs, had acquired their perfect form; the heart seemed to be composed of two ventricles, like two contiguous globules, united at their superior part with the auricles; and two successive pulses were remarked both in the ventricles and auricles, as if there had been two separate hearts.

But I will follow Malpighius no farther. The remainder of the detail regards the growth and perfection of the parts till the chick breaks the shell in which it is inclosed, and becomes an inhabitant of a new world. The heart is the last part that assumes its proper figure, by the union of its ventricles, which happens not till the eleventh day.

We are now in a condition to form a distinct judgment concerning the value of Harvey's experiments. It is probable that this celebrated anatomist did not make use of the microscope, (which was, indeed, very imperfectly known in his days), otherwise he never would have affirmed, that there was no difference between the cicatrice of impregnated and unimpregnated eggs; he never would have said, that the semen of the male produced no change upon the egg, and particularly upon the cicatrice; he never would have advanced, that nothing was perceptible before the end of the third day; that the animated point appeared first; and that the white point was transformed into the animated point: he would have perceived that the white point was the bubble or globule which contained the whole apparatus of generation; and that all the rudiments of the fœtus commenced there from the moment of receiving the impregnation of the cock: he would likewise have discovered, that, without this impregnation, it contains nothing but an unformed mass, which could never become animated; because, in fact, it is not organized like an animal, and because it is only after this mass, which ought to be regarded as a collection of the organic particles of the female semen, is penetrated by the organic particles of the male semen, that an animal is formed. This formation is instantaneous; but the motions of the new animal are imperceptible till 40 hours after the process of incubation has commenced: he would not have assured us that the heart is first formed, and that the other parts are successively joined to it by juxta-position; since it is apparent, from the experiments of Malpighius that the rudiments of all the parts are formed at once, but that they become perceptible only in proportion as they are successively unfolded: lastly, if he had seen, as Malpighius saw, he would not have positively asserted, that no impression of the male seed remained in the eggs, and that it was only by contagion that they were impregnated, &c.

It is likewise proper to remark, that what Harvey has said concerning the parts of generation of the cock is by no means exact. He affirms, that the cock has no penis capable of entering the vagina of the hen. It is certain, however, that this animal, in place of one penis, has a couple, which both act at the same time; and this action is a vigorous compression, if not an actual copulation. It is by this double organ that the cock throws his seminal liquor into the uterus of the hen.

Let us now compare Harvey's experiments upon female deer with those of De Graaff upon female rabbits; and, though De Graaff believed, as Harvey did, that all animals proceed from eggs, we shall find a great difference in the manner in which these two anatomists have perceived the first formation, or rather the expansion, of the fœtuses of vivaporous animals.

After exerting every effort to prove, by arguments drawn from comparative anatomy, that the testicles of vivaporous females are true ovaria, Graaff explains the manner in which the eggs are detached from the ovaria, and fall into the *horns* of the uterus. He then relates the remarks he made upon a rabbit which he dissected half an hour after copulation. The horns of the uterus, he says, were uncommonly red; there was no change either in the ovaria, or in the eggs which they contained; and there was not the least appearance of semen in the vagina, in the uterus, or in the *Fallopian tubes*.

Having dissected another rabbit, six hours after copulation, he observed, that the follicles, or coats, which in his estimation, contain the eggs in the ovarium, were become red; but he found no male semen either in the ovaria or any where else. Twenty hours after copulation, he dissected a third; he remarked in one ovarium three, and in the other five follicles much altered; for, instead of being clear and limpid, they had become opaque and reddish. In another, dissected twenty-seven hours after copulation, the horns of the uterus, and the superior canals which terminate in them, were still more red; and their extremities embraced the ovarium on all sides. In another, which was opened forty hours after copulation, he found in one ovarium seven, and in the other three follicles changed. Fifty-two hours after copulation, he examined another, and found in one ovarium four changed follicles, and one in the other; and having opened these follicles, he discovered in them a kind of glandulous liquor, with a small cavity in the middle, where he could perceive no fluid, which made him suspect that the transparent liquor usually contained in the follicles, and which, he says, is inclosed in its own membranes, might have been discharged by some kind of rupture. He searched for this matter in the canals which terminate in the horns of the uterus, and in the horns themselves; but he found nothing. He only remarked, that the membranes which line the horns of the

uterus were much swelled. In another rabbit, dissected three days after copulation, he observed, that the superior extremity of the canal, which terminates in the horns of the uterus, straitly embraced the ovarium on every side; and, having separated it from the ovarium, he remarked, in the right ovarium, three follicles somewhat larger and harder than usual. After searching, with great care, the canals above mentioned, he discovered, he says, an egg in the right canal, and two more in the right horn of the uterus, so small that they exceed not mustard seeds. These little eggs had each two membranes, and the internal one was filled with a very limpid liquor. Having examined the other ovarium, he found four changed follicles; three of them were whiter, and had likewise some limpid liquor in their centres; but the fourth was of a darker colour, and contained no liquor, which made him suspect that the egg had escaped. He therefore searched the corresponding canal and horn of the uterus; he found an egg in the superior extremity of the horn, which was exactly similar to those he had discovered in the right horn. He alledges, that the eggs, when they are separated from the ovarium, are ten times less than before their separation; and this difference in size, he imagines, is owing to the eggs, while in the ovarium, containing another matter, namely, the glandulous liquor which he remarked in the follicles.

Four days after copulation, he opened another rabbit, and found in one ovarium four, and in the other three follicles void of eggs: in the horns corresponding to the ovaria, he found four eggs on one side, and three in the other. These eggs were larger than those he had discovered three days after copulation. They were nearly of the size of the lead-shot used for shooting small birds; and he remarked, that in these eggs, the interior membrane was separated from the exterior, and appeared as if a second egg was contained within the first. In another, dissected five days after copulation, he found five empty follicles in the ovaria, and an equal number of eggs in the uterus, to which they adhered very firmly. These eggs were as large as the shot employed for killing hares; and the internal membrane was still more apparent than in the last experiment. Having opened another rabbit, six days after copulation, he found in one of the ovaria six empty follicles, but only five eggs in the corresponding horn of the uterus; and they seemed to be all accumulated into one mass: in the other ovarium, he saw four empty follicles, and found but one egg in the corresponding horn. These eggs were of the size of the largest fowling shot. Seven days after copulation, our anatomist opened another rabbit, and he found in the ovaria some empty follicles, which were larger, harder, and more red than those he had formerly observed; and he perceived as many transparent tumors in different parts of the uterus; and, having opened them, he took out the eggs, which were as large as small pistol bullets. The internal membrane was more distinct than formerly; and within this membrane he saw nothing but a very clear liquor. In another, dissected eight days after copulation, he found in the uterus the tumors or cells which contain the egg; but they adhered so strongly to the uterus, that he could not detach them. In another, which he opened nine days after copulation, he found the cells containing the eggs greatly enlarged; and he perceived, in the middle of the liquor inclosed by the internal membrane, a small thin cloud. In another, which he opened ten days after copulation, the small cloud was thicker and darker, and formed an oblong body like a little worm. Lastly, twelve days after copulation, he distinctly perceived the embryo, which, though two days before it was only an oblong body, was now so apparent, that he could distinguish its different members. In the region of the breast, he saw two red and two white points, and, in the abdomen, a mucilaginous reddish substance. Fourteen days after copulation, the head of the fœtus was large and transparent; the eyes were prominent; the mouth was open; the rudiments of the ears appeared; the back-bone was whitish, and bended towards the sternum; and small blood-vessels arose from each side of it, the ramifications of which extended along the back as far as the legs. The two red points were considerably enlarged, and appeared like the rudiments of the ventricles of the heart; on each side of the red points he saw two white ones, which were the rudiments of the lungs. In the abdomen he saw the rudiments of the liver, which was reddish, and a small body twisted like a thread, which was the stomach and intestines. After this, till the 31st day, when the female rabbit brings forth, there was nothing to be remarked but the gradual expansion and growth of the parts which were already formed.

From these experiments, De Graaff concludes, that all viviparous females have eggs; that these eggs are contained in the ovaria or testicles; that they cannot be separated till they are fecundated by the semen of the male; because, says he, the glandulous liquor, by means of which the eggs are enabled to escape from their follicles, is not secreted till after an impregnation by the the male. He alledges, that those who imagine they have seen pretty large eggs in three days, have been deceived; because, in his opinion, the eggs, though fecundated, remain longer in the ovarium, and, in place of augmenting, they become ten times less than formerly, and they never begin to grow till after their descent from the ovaria into the uterus.

By comparing these observations of De Graaff with those of Harvey, we will easily perceive that the latter has missed the principal facts: and, though there are several errors both in the reasoning and in the experiments

of De Graaff, this anatomist, as well as Malpighius, have discovered themselves to be better observers than Harvey. They agree in all fundamental points, and both of them contradict Harvey. He perceived not the alterations which take place in the ovaria; he saw not in the uterus those small globules which contain the materials of generation, and which are called eggs by De Graaff. He never suspected that the fœtus existed in the egg; and, though his experiments give us tolerable exact ideas concerning what happens during the growth of the fœtus, he furnishes no information concerning the commencement of fecundation, nor concerning the first expansion of the fœtus. Schrader, a Dutch physician, who had a great veneration for Harvey, acknowledges that he cannot be trusted in many articles, and particularly in what relates to the first formation of the embryo; for the chick really exists in the egg before incubation: and, he says, that Joseph of Aromatarius was the first who made this material observation. Besides, though Harvey alledged that all animals proceeded from eggs, he never imagined that the testicles of females contained eggs; and it was only from a comparison between the sac, which he believed to be formed in the uterus of viviparous animals, with the growth and covering of the eggs in oviparous animals, that he maintained that all animals were produced from eggs; and even this is but a repetition of what Aristotle had said before him. Steno was the first who pretended to have discovered eggs in the ovaria of females. He says, that, in dissecting a female sea-dog, he perceived eggs in the testicles, though this animal be viviparous: and he adds, that the testicles of women are analogous to the ovaria of oviparous animals, whether the eggs themselves fall into the uterus, or only the matter which they contain. Steno first discovered these supposed eggs; De Graaff is willing to assume the discovery to himself; and Swammerdam warmly disputes the point with him, and alledges that Van-Horn had seen them before De Graaff. This last writer, it is true, has been accused of asserting many things which have been contradicted by experiments: he even pretended, that a certain judgment might be formed of the number of fœtuses in the uterus, by the number of cicatrices or empty follicles in the ovaria. In this he is contradicted by the experiments of Verrheyen, by those of M. Mery, and by some of his own, where he found fewer eggs in the uterus, than cicatrices in the ovaria. Besides, we shall demonstrate that what he says concerning the separation of the eggs, and the manner in which they descend into the uterus, is by no means exact; that no eggs exist in the testicles of females; that what is seen in the uterus is not an egg; and that the systems which have been deduced from the observations of this celebrated anatomist are perfectly chimerical.

This pretended discovery of eggs in the testicles of females attracted the attention of most anatomists. They only found, however, in the testicles of viviparous females, small bladders. These they hesitated not to consider as real eggs; and, therefore, they called the testicles *ovaria*, and the vesicles *eggs*. They asserted also, like De Graaff, that these eggs differed in size in the same ovarium; that the largest in the ovaria of women exceeded not the bulk of a small pea; that they are very small in young girls; but that they increased with age and intercourse with men; that not above 20 could be reckoned in each ovarium; that these eggs are fecundated in the ovarium by the spiritous part of the male semen; that they then separate and fall into the uterus through the Fallopian tubes, where the fœtus is formed of the internal substance of the egg, and the placenta of its external parts; that the glandulous matter, which exists not in the ovarium till after a fruitful embrace, compresses the egg, and excludes it from the ovarium, &c. But, though Malpighius, who examined more accurately, detected many errors committed by these anatomists even before they were received; yet most physicians adopted the opinion of De Graaff, without regarding the observations of Malpighius, which were nevertheless of the greatest importance, and which received much weight from the experiments of his disciple Valisnieri.

Malpighius and Valisnieri, of all naturalists, appear to have written with most judgment and acuteness on the subject of generation. We shall, therefore, give an account of their experiments and remarks.

Malpighius, after examining the testicles of a number of cows and other female animals, assures us, that he found, in the testicles of all of them, vesicles of different sizes, whether the females were very young or adults. These vesicles are enveloped in a pretty thick membrane, the inside of which is interspersed with blood-vessels; and they are filled with a kind of lymph or liquor, which coagulates and hardens by the heat of a fire, like the white of an egg.

In process of time, a firm yellow body adheres to the testicles. It is prominent, increases to the size of a cherry, and occupies the greatest part of the ovarium. This body consists of several angular lobes, the position of which is very irregular, and it is covered with a coat or membrane interspersed with nerves and blood-vessels. The form and appearance of this yellow body varies considerably at different times. When it exceeds not the size of a grain of millet, it is roundish, and its substance, when cut, has a warty appearance. We often find an external covering round the vesicles of the ovaria, which consists of the same substance with the yellow bodies.

When the yellow body has become nearly of the size of a pea, it resembles a pear; and, in the centre of it, there is a small cavity filled with liquor. The same thing may be remarked when it is as large as a cherry. In some of these yellow bodies, after they have arrived

at full maturity, Malpighius affirms that he saw, towards the centre, a small egg with its appendages, about the size of a millet seed; and, after they had discharged these eggs, they were flaccid and empty. They then resembled a cavernous canal; and the void cavities were as large as peas. He conceived that Nature designed this yellow glandulous body for the preservation of the egg, and for making it escape from the testicles; and that, perhaps, it contributed to the formation of the egg; consequently, he remarks, the vesicles which are at all times found in the ovarium, and always differ in size, are not the true eggs which receive the impregnation, but serve only to produce the yellow bodies in which the eggs are formed. Besides, though these yellow bodies are not always found in every ovarium; yet we always find the rudiments of them. Malpighius found the marks of them in new born heifers, in cows with calf, and in pregnant women; and, therefore, he properly concludes, that these yellow glandulous bodies are not, as De Graaff asserts, an effect of impregnation. The yellow bodies, he remarks, produce unfecundated eggs, which fall out of the ovarium independent of any communication with the male, and also those which fall after impregnation. When the impregnated eggs fall into the uterus, every thing proceeds in the manner described by De Graaff.

These observations of Malpighius demonstrate, that the testicles of females are not real ovaria; that the vesicles they contain are not eggs; that these vesicles never fall into the uterus; and that the testicles, like those of males, are only reservoirs containing a liquor which may be regarded as female semen in an imperfect state. This semen is matured in the yellow glandulous bodies, of which it fills the internal cavities, and flows out after the yellow bodies have acquired their full size.

But, before we form a judgment concerning this important point, we must attend to the remarks of Valisnieri.

In the year 1692, Valisnieri began his experiments upon the testicles of the sow. The testicles of the sow differ from those of cows, of mares, of sheep, of she-asses, of female-dogs, of she-goats, of women, and of most viviparous animals; for they resemble a small bunch of raisins, the grains of which are round and prominent on the outside; between these grains are smaller ones, which have not acquired full maturity. These grains appear not to be covered with a common membrane. They are, says he, analogous to the yellow bodies observed in cows by Malpighius; they are round, and of a reddish colour; their surface is interspersed with blood-vessels, like the eggs of viviparous animals; and the whole grains together form a mass which is larger than the ovarium. With a little address, these grains may be separated from the ovarium, and each of them, after separation, leaves a nitch or depression.

These glandulous bodies are not of the same colour. In some sows they are more red; in others more clear; and they are of all sizes, from the smallest seed, to that of a raisin. On opening them, a triangular cavity appears, filled with a limpid liquor, which coagulates with heat, and becomes white, like that which is contained in the vesicles. Valisnieri expected to find the egg in some of these cavities: but in this he was disappointed; though he made a careful search into all the glandulous bodies of a number of sows, and other animals, he could never discover the egg, which Malpighius affirms he once or twice found.

Under these glandulous bodies, the vesicles of the ovarium appeared. They were more or less numerous, according as the glandulous bodies were larger or smaller; for, in proportion to the largeness of the glandulous bodies, the vesicles diminished. Some vesicles were of the size of a lentil, and others exceeded not that of a millet seed. In the testicles, when raw, from 20 to 35 vesicles might be reckoned; but, when boiled, a much greater number appear, and they are so firmly attached, that they cannot be separated without breaking some of them.

Having examined the testicles of a young sow, which had never brought forth, he found, as in the others, the glandulous bodies; and their triangular cavities were likewise filled with lymph; but he could not discover any eggs either in the one or the other. The vesicles of this young sow were more numerous than in those which had brought forth, or those which were impregnated at the time of examination. In the testicles of another sow, which was far advanced in pregnancy, Valisnieri found two of the largest glandulous bodies, which were flaccid and empty, and others, of a lesser size, in their ordinary state; and, in several others which he dissected when with young, he remarked, that the number of glandulous bodies was always greater than the number of fœtuses. This fact confirms what we observed concerning the experiments of De Graaff, and proves that they are by no means exact. What he calls follicles of the ovarium are only the glandulous bodies, the number of which always exceeds that of the fœtuses. In the ovaria of a sow, two or three months old, the testicles were pretty large, and interspersed with vesicles of a considerable size. Among the vesicles, the beginnings of four glandulous bodies appeared in one testicle, and of seven in the other.

After these experiments upon sows, Valisnieri repeats those of Malpighius upon cows, and he found them to be exactly conformable to truth. He indeed acknowledges, that he was never able to discover the egg which Malpighius imagined he had seen once or twice in the interior cavities of the glandulous bodies. After a fruitless search in the testicles of so many different females, it was natural to think that Valisnieri would at least have doubted the existence of such eggs. But prejudice in favour of system made him admit, contrary to his

own experience, the existence of eggs, which neither he nor any other man ever saw, or ever will see.

It is, perhaps, impossible to make a greater number, or more exact experiments, than those of Valisnieri. Among other animals, he examined the ewe, and found, that she never has more glandulous bodies in her testicles than fœtuses in the uterus. In young ewes, which were never impregnated, there is but one glandulous body in each testicle, and, when one is emptied, it is succeeded by another; if a ewe has one fœtus in the uterus, she has only one glandulous body in her testicles; and if she has two fœtuses, she has likewise two glandulous bodies. This glandulous body occupies the greatest part of the testicle; and, after it is emptied and disappears, another begins so grow for the purpose of a future generation.

In the testicles of a she-ass, he found vesicles as large as small cherries; which is an evident proof that they are not eggs, as it would be impossible for them to pass, by the Fallopian tubes, into the uterus.

The testicles of female wolves, dogs, and foxes, are covered with a membrane, like a purse, which is an expansion of that which surrounds the horns of the uterus. In a bitch which began to be in season, but had not been approached by the male, Valisnieri found the internal part of this purse, which does not adhere to the testicle, moistened with a liquor that resembled whey, and two glandulous bodies in the right testicle, about two lines in diameter, and which occupied nearly the whole extent of the testicle. Each glandulous body had a small nipple, with a distinct fissure, from which, without pressing it, there issued a liquor like clear whey; he therefore concluded, that this liquor was the same which he found in the purse. He blew into this fissure with a pipe, and the whole glandulous body immediately swelled; and, having introduced a bristle, he easily penetrated to its bottom. He opened the body on that side where he had introduced the bristle, and found an internal cavity which communicated with the nipple, and contained a considerable quantity of liquor. Valisnieri was always in hopes of discovering the egg; but these hopes, notwithstanding all his researches, were uniformly frustrated. He likewise found, in the left testicle, two glandulous bodies very similar to those in the right. He boiled two of these glandulous bodies, hoping that, by this means, he might discover the egg; but still without any measure of success.

Having dissected another bitch four or five days after she had received the male, he found in the testicles three glandulous bodies exactly similar to the former. He searched every where for the egg; but he was still disappointed. By the assistance of the microscope, he discoverd the glandulous bodies to be a net-work, composed of an infinite number of globular vesicles, which served to filtre the liquor that issued through the nipple.

He then opened another bitch which was not in season, and having tried to introduce air between the testicle and the purse which covered it, he found that it dilated like a bladder filled with air. Having removed the purse, he discovered two glandulous bodies upon the testicles; but they had neither nipple nor fissure, and no liquor distilled from them.

In another bitch that had brought forth about five whelps two months before, he found five glandulous bodies; but they were much diminished in size, and they began to disappear, without leaving any cicatrices. There remained only a small cavity in their centre; but it contained no liquor.

Not satisfied with these, and many other experiments, Valisnieri, who passionately desired to discover this pretended egg, called together the best anatomists his country afforded, and, among others, M. Morgagni; and, having opened a young bitch that was for the first time in season, and that had been covered three days before, they examined the vesicles of the testicles, the glandulous bodies with their nipples, their canals, and the liquor in their internal cavities; but they could perceive no eggs. He then, with the same intention, made experiments on she-goats, foxes, cats, a number of mice, &c. In the testicles of all these animals, he uniformly found the vesicles, and frequently the glandulous bodies, with the liquor they contained; but no egg ever appeared.

In fine, being desirous of examining the testicles of women, he had an opportunity of opening a young country-woman, who had been some years married, and who was killed by a fall from a tree. Though of a robust and vigorous constitution, she had never born any children. He endeavoured to discover if the cause of her barrenness existed in the testicles; and he found that the vesicles were all filled with a blackish and corrupted matter.

In a young girl of eighteen years of age, who had been brought up in a convent, and who had every appearance of real virginity, he found the right testicle a little longer than the left: it was of an oval figure, and its surface was somewhat unequal. This inequality was occasioned by five or six vesicles which protruded on the outside of the testicle. One of these vesicles, which was more prominent than the rest, he opened, and a quantity of lymph rushed out. This vesicle was surrounded with a glandulous substance, in the shape of a crescent, and of a reddish yellow colour. He cut the testicle transversely, and found a number of vesicles filled with limpid liquor; and he remarked, that the Fallopian tube of this testicle was redder and somewhat longer than the other, as he had often observed in other animals when they were in season.

The left testicle was whiter, and its surface more smooth; for, though some vesicles were a little prominent, none of them were in the form of nipples; they

were all similar to each other, and the corresponding Fallopian tube was neither swelled nor red.

In the body of a girl, aged five years, he found the testicles with their vesicles, their blood-vessels, and their nerves.

In the testicles of a woman of sixty years, he discovered some vesicles, and the vestiges of a glandulous substance, like large points of an obscure yellowish brown colour.

From all these observations, Valisnieri concludes, that the work of generation is carried on in the female testicles, which he continued to regard as ovaria, though he never could find any eggs in them, and though, on the contrary, he had discovered that the vesicles were not eggs. He says, likewise, that, for the impregnation of the egg, it is not necessary that the male semen should enter the uterus. He supposes, that the egg escapes through the nipple of the glandulous body after being impregnated in the ovarium; that it then falls into the Fallopian tube; that it gradually descends, and at last attaches itself to the uterus: he adds, that he is fully persuaded, that the egg is concealed in the cavity of the glandulous body, though neither he nor any other anatomist was ever able to discover it.

In his estimation, the spirit of the male seed ascends into the ovarium, penetrates the egg, and gives motion to the fœtus which previously existed in the egg. In the ovarium of the original mother of mankind, he observes, were eggs, which contained not only all the children she produced, but of the whole human race. If this chain of infinite individuals contained in one be incomprehensible to us, it is entirely owing to the imbecility of our minds, of which we have daily proofs. But it is not, therefore, less consonant to truth, that all the animals which have existed, or can exist, were created at once, and were all included in their first mothers. The resemblance of children to their parents is owing, he continues, to the imagination, which acts so forcibly on the fœtus as to produce stains, monstrosities, disorder of parts, and extraordinary concretions, as well as perfect similarities.

This system of eggs, though it explains nothing, and has no foundation in nature, would have obtained the universal suffrages of physicians, if nearly about the same time, another opinion had not sprung up, founded upon the discovery of spermatic animals.

This discovery, which we owe to Leeuwenhoek and Hartsoeker, was confirmed by Andry, Valisnieri, Bourguet, and many other observers. I shall relate what has been advanced concerning those spermatic animals which are found in the semen of all males. Their number is so great, that the semen seems to be entirely composed of them; and Leeuwenhoek pretends to have seen many millions of them in a drop less than the smallest grain of sand. Though none of them appear in females, they are found in the emitted semen of all males, in the testicles, and in the vesiculæ seminales. When the semen of a man is exposed to a moderate heat, it thickens, and the motion of all the animalcules is suddenly stopped. But, when allowed to cool, it dilutes, and the animals continue in motion till the liquor again thickens by evaporating. The more this fluid is diluted, the number of animalcules is augmented; and, when greatly diluted by the addition of water, the whole substance of the fluid seems to be composed of animals. When the motion of the animalcules is about to cease, either on account of heat or of drying, they appear to approach nearer each other, to have a common circular motion in the centre of the small drop under observation, and to perish, all of them, at the same instant. But, when the quantity of liquor is greater, it is easy to distinguish them dying in succession.

These animalcules are said to be of different figures in different animals; but they are all long, thin, without any members, and move with rapidity in every direction. The fluid in which they are contained, as formely remarked, is much heavier than blood. The semen of a bull, when chymically analysed by Verrheyen, yielded first phlegm, then a considerable quantity of fœtid oil, a very small proportion of volatile salt, and more earth than he expected. This author was surprised that he could draw no spirit from the distillation of semen; and, as he imagined it contained a great quantity of spirits, he attributed the evaporation of them to their subtilty. But may we not suppose, with more probability, that it contains little or no spirits? Neither the consistence, nor the odour of this fluid, indicate the presence of ardent spirits, which never abound but in fermented liquors; and, with regard to volatile spirits, the horns, bones, and solid parts of animals, afford more of them than the fluids. What has received the appellation of seminal spirits, *aura seminalis*, among anatomists, has, perhaps, no existence; and it is certain, that the moving bodies apparent in the seminal fluid are not agitated by these spirits. But, that we may be enabled to pronounce more clearly concerning the nature of the semen, and of its animalcules, we shall present the reader with the principal observations which have been made on the subject.

Leeuwenhoek, having examined the semen of a cock, perceived a number of animals similar to river eels; but they were so minute, that 50,000 of them were not equal in bulk to a grain of sand. Of those in the semen of a rat, it required, he says, many millions to make the thickness of a hair, &c. This excellent observer was persuaded, that the whole substance of the semen was only a mass of animalcules. He saw these animalcules in the semen of men, of quadrupeds, of birds, of fishes, and of insects. In the semen of a grasshopper, the animalcules were long, and extremely thin. They appeared, he says, to be attached by their superior end; and the other end,

which he calls their tail, had a brisk motion, like that of the tail of a serpent when its head is fixed. In the semen of young animals, when examined before they have any sexual appetite, he alledges that he saw the same minute animals, and that they had no motion: but, when the season of love arrived, the animalcules moved with great vivacity.

In the semen of a male frog, he saw animalcules; but, at first, they were imperfect, and had no motion: some time after, he found them alive. They were so minute, he observes, that ten thousand of them were only equal in bulk to a single egg of the female.

In the semen of a man and that of a dog, he pretended to see two species of animalcules, resembling males and females. Having shut up the semen of the dog in a small vial, he says, that a great number of animalcules died the first day; that, on the second and third day, still more of them died; and that few of them were alive on the fourth day. But, having repeated this experiment on the semen of the same dog, he found, at the end of seven days, the animalcules as brisk and lively as if they had been newly extracted from the animal: and, having opened a bitch that, some time before the experiment, had been three times covered by the same dog, he could not perceive, with his naked eye, any male semen in the uterus or its appendages; but, by the assistance of the microscope, he found the spermatic animals of the dog in both *horns* of the uterus: in that part of the uterus which is nearest the vagina, he discovered great numbers, which evidently proves, says he, that the male semen enters the uterus, or, at least, that the spermatic animals of the dog had arrived there by their own motion, which enables them to pass over four or five inches in half an hour. In the uterus of a female rabbit, which had just received the male, he observed an infinite number of spermatic animals. He remarks, that the bodies of these animals are round; that they have long tails; and that they often change their figure, especially when the fluid in which they swim begins to dry up.

Valisnieri and Bourguet perceived small worms in the semen of a rabbit: one of their extremities was longer than the other; they were very active in their motions, and beat the fluid with their tails: sometimes they raised themselves to the top of the liquor, and sometimes sunk to the bottom; at other times they turned round, and twisted like serpents: in fine, says Valisnieri, I clearly perceived them to be real animals: 'E gli riconobbi, e gli giudicai senza dubitamento alcuno per veri, verissimi, arciverissimi vermi.' This author, though prejudiced in favour of the ovular system, admitted the actual existence of spermatic animals.

M. Andry pretends, that he could find no animals in human semen previous to the age of puberty; that they exist not in the semen of very old men; that there are few of them in those who are affected with the venereal disease, and that these few are in a languishing state; that none of them appear alive in impotent persons; and that the animalcules in the semen of men have a larger head than those of other animals, which corresponds, he observes, with the figure of the fœtus and infant; and he adds, that those who use women too frequently have generally few or no animalcules in their semen.

Leeuwenhoek, Andry, and others, exerted every effort against the egg-system: they discovered in the semen of all males living animalcules; they proved that these animalcules could not be regarded simply as inhabitants of this fluid, since the quantity of them was larger than that of the fluid itself; and since nothing similar to them existed either in the blood, or in any other of the animal fluids: they maintained, that, as females furnished no animalcules, their fecundity was solely derived from the males; that the existence of living animals in the semen throws more light upon the nature of generation than all the former discoveries on this subject; because the greatest difficulty in generation is to conceive how life is first produced, the future expansion and growth of the parts being only accessary operations; and, consequently, that not a doubt remained of these animalcules being destined to become men, or perfect animals, according to their species. When the improbability was objected to them, that millions of animalcules, all equally capable of becoming men, should be employed for this purpose, while only one of them was to enjoy the singular advantage of being admitted into the condition of humanity; when it was demanded of them, why this useless profusion of human germs was employed? they replied, That it corresponded with the usual magnificence of nature; that, in plants and trees, millions of seeds were produced, while only a few of them succeeded; and that, therefore, we ought not to be surprised at the prodigious number of spermatic animals. When the extreme minuteness of a spermatic worm, compared with the body of a man, was mentioned to them as a difficulty, they answered, that the seeds of trees, of the elm, for example, were equally minute, when compared with the perfect individuals; and they added, with equal propriety, metaphysical arguments, by which they proved, that largeness and minuteness were only relations, and that the transition from small to great, or from great to small, was performed by nature with greater facility than we could possibly imagine.

Every thing, therefore, they conclude, concurs in establishing this system of generation, and in overturning that which is founded on the notion of eggs; and, though eggs really existed in viviparous animals, as well as in the oviparous, these eggs would only be the

matter necessary for the growth and expansion of the spermatic worm, which enters by the pedicle which attaches the egg to the ovarium, where it finds abundance of nourishment.

In the history of the Academy of Sciences, ann. 1701, some objections are proposed by M. Mery against the egg-system. This able anatomist maintained, with propriety, that the vesicles found in the testicles of females are not eggs; that they adhere so firmly to the internal surface of the testicle, as not to admit of a natural separation; and that, though they could separate from the substance of the testicle, it was impossible for them to get out of it, because the texture of the common membrane inclosing the whole testicle is so firm and strong, that it is impracticable to conceive the possibility of its being pierced by a vesicle, or round soft egg. And, as most anatomists and physicians were prepossessed in favour of the egg-system, and imagined that the number of cicatrices in the testicles corresponded with the number of fœtuses, M. Mery showed such a quantity of these cicatrices in the testicles of a woman, as, upon the supposition of the truth of this system, would have argued a fecundity beyond the power of credibility. These difficulties stimulated other anatomists of the Academy, who were partizans of the eggs, to make new researches. M. Duverney examined the testicles of cows and sheep, and maintained, that the vesicles were eggs, because some of them adhered less firmly to the testicles than others; and that it was natural to suppose they separated altogether when they arrived at full maturity; especially as, by blowing into the cavity of the testicle, the air passed between the vesicles and the adjacent parts. M. Mery simply replied, that this proof was insufficient, as these vesicles were never seen separate from the testicles. M. Duverney farther observed the glandulous bodies upon the testicles; but he never considered them as parts essential to generation, but as accidental excrescences, like gall-nuts on the oak. M. Littre, whose prejudices in favour of eggs were still stronger maintained not only that the vesicles were eggs, but even assured us, that he discovered in one of them a well-formed fœtus, of which he could distinguish both the head and trunk; and he has even given their dimensions. But, admitting this wonder, which never appeared to any eyes except his own, to be convinced of the doubtfulness of the fact, we have only to peruse his memoir. From his own description, it appears that the uterus was schirrous, and the testicle very much corrupted; that the vesicle or egg, which contained the pretended fœtus, was much less than common, &c.

Nuck furnishes us with a celebrated experiment in favour of eggs. He opened a bitch three days after copulation; he drew out one of the *horns* of the uterus, and tied it in the middle, so as to prevent the superior part of the Fallopian tube from having any communication with the inferior. After this, he replaced the *horn* of the uterus, and closed the wound. Twenty-fours hours afterwards, he again opened the wound, and found two fœtuses in the superior part of the tube, that is, between the testicles and the ligature; and there was no fœtus in the under part. In the other horn of the uterus that was not tied, he found three fœtuses, regularly disposed; which proves, says he, that the fœtus proceeds not from the male semen, but that it exists in the egg of the female. Supposing this experiment, which is single, had been often repeated with the same success, the conclusion the author draws from it is not legitimate: it proves no more than that the fœtus may be formed in the superior part of the horn of the uterus, as well as in the inferior; and it is natural to think that, by the pressure of the ligature, the seminal liquor in the inferior part was forced out, and, of course, frustrated the work of generation in that region of the uterus.

This is all the length that anatomists and physicians have proceeded in the subject of generation. It only remains that I deliver the results of my own experiments and inquiries; and I shall leave the reader to judge whether my system be not infinitely more consonant to nature than any of those which I have enumerated.

CHAPTER VI.

Experiments on Generation.

I OFTEN reflected on the above systems of generation, and was daily more and more convinced that my theory was infinitely more probable. At length I began to suspect that those living organic particles, from which I thought all animals and vegetables derived their origin, might be recognized by the assistance of good glasses. My first notion was, that the spermatic animalcules found in the seminal fluid of all males, might probably be those very organic particles; and I reasoned in this manner. If all animals and vegetables contain an infinite number of organic particles, these particles should be most abundant in their seeds, because the seed is an extract from all the organic parts, and especially from those which are most analogous to the individual. I therefore determined to examine with the microscope the seminal liquors of males and females, and the germs of plants; and, at the same time, I imagined, that the cavities of the glandulous bodies of the uterus might be the reservoirs of the female semen. Having communicated my ideas on this subject to my ingenious friends Mr. Needham, M. Daubenton, M. Gueneau, and M. Dalibard, they encouraged me to commence a set of experiments in order to throw light upon this mysterious operation of nature. All of these gentlemen occasionally attended and assisted me; but particularly M. Daubenton, who was never absent, and who was witness to every experiment I made.

I employed a double microscope, which I had from Mr. Needham, being the same with which he made his numerous and ingenious observations.

I. Having procured the seminal vessels of a man who died a violent death, and whose body was still warm, I extracted all the liquor from them, and put it in a vial. I examined, by the microscope, a drop of this liquor, without any dilution. As soon as the vapours, which arose from the liquor, and obscured the glass, were dissipated, I observed pretty large filaments which, in some places, spread out into branches, and, in others, intermingled with each other. These filaments clearly appeared to be agitated with an internal undulatory motion, like hollow tubes, which contained some moving substance. I saw distinctly two of these filaments, which were joined longitudinally, separate from each other in the middle, and alternately approach and recede, like two stretched cords, fixed by the ends, and drawn asunder at the middle. These filaments were composed of globules, which touched one another, and resembled a chaplet of beads. I then observed filaments which were blown up, and swelled in certain places, and perceived small oval globules issue from these swelled parts, which had a vibratory motion like that of a pendulum. These small bodies were attached to the filaments by little threads, which gradually lengthened as the bodies moved: and, lastly, I observed these small bodies detach themselves entirely from the large filament, and draw after them the little thread, which resembled a tail. As the liquor was too thick, and the filaments too near each other, I diluted another drop with pure rain water, after satisfying myself that it contained no animalcules. I then perceived that the filaments were more distant from each other, and saw distinctly the motion of the small bodies above taken notice of, which was more free, and they appeared to swim with greater agility, and trailed their tails after them with greater ease; and, if I had not seen them separate from the filaments, and draw the threads out of them, I should have believed, from this second observation, the moving bodies to be real animals, and their threads to be tails. After examining with great attention one of the filaments, which was three times thicker than the small bodies, I perceived two of these bodies detach themselves with much difficulty, and drag after them long slender threads, which impeded their motion.

This seminal liquor was at first too thick; but it gradually became more fluid, and, in proportion as its fluidity augmented, the phænomena changed, in the manner just mentioned.

II. When the seminal liquor became more fluid, the filaments disappeared; but the small bodies were exceedingly numerous. Their motion, for the most part, resembled that of a pendulum: each of them had a long thread, from which they evidently endeavoured to disengage themselves; their progressive motion was extremely slow, during which they vibrated to the right and left. At each vibration, they had a rolling unsteady motion; so that, besides their horizontal vibrations, they roll or vibrate in a vertical direction; which proves these bodies to be of a globular figure, or at least that their inferior part is not a flat base sufficiently extensive to keep them in one position.

III. At the end of two or three hours, when the liquor was more fluid, a still greater number of these moving bodies appeared. They were more free of incumbrances;

their threads were shorter; their progressive motion was more direct; and their horizontal vibration was greatly diminished; for the longer the threads were, their vibratory motion was increased, and their progress forward was diminished.

IV. In five or six hours, the liquor had almost all the fluidity it could acquire, without being decomposed. We then discovered that most of these small moving bodies were entirely disengaged from their threads. Their figure was oval: they moved forward with considerable quickness; and by their motion backward and forward, and to every side, they had now more than ever the appearance of real animals. Those which had tails or threads sticking to them, seemed to have less vivacity than the others. Of those which had no threads, some appeared to change both their figure and their size. Some were round; but the greatest part of them were oval, and a few were thicker at the extremities than in the middle. The rolling and vibratory motions were still perceptible.

V. In 12 hours, the liquor had deposited, at the bottom of the vial, a kind of gelatinous, bluish, or rather ash-coloured substance; and the fluid that swimmed on the top was nearly as clear as water, only it had a tincture of blue, like water in which a small quantity of soap had been dissolved. It still, however, retained its viscosity. The little bodies, which were now entirely freed from their threads, moved with great activity on all sides, and some of them turned round their centres. Most of them were oval, though some of them were round. I have seen them change figures, and from oval become round. I have seen them divide, and from a single oval or globule, separate into two. Their activity always increases as their size diminished.

VI. At the end of 24 hours, the liquor had deposited a greater quantity of gelatinous matter, which I diluted, with some difficulty, in water. It appeared to consist of a multitude of opaque tubes resembling lace, but without any regularity or the smallest motion. In the clear semen itself, there were a few small bodies still moving; next day the number was still farther diminished. After this, nothing was to be seen but globules without the least appearance of motion.

These experiments were often repeated with great exactness; and they convinced me that the threads which adhere to the moving bodies are not tails, nor any part proper to these bodies; for the tails or threads have no proportion to the rest of the body; they are of different dimensions, though the bodies are always nearly of the same size at the same time. The motion of the globule is embarrassed in proportion to the length of the tail. When the tail is too long, it sometimes prevents the progressive motion altogether, leaving nothing but the vibrations from right to left; and the globules make evident efforts to disentangle themselves from this incumbrance.

VII. Having procured the seminal fluid of another man recently dead, I put a pretty large drop of it on the glass, which soon liquified without any mixture. It had the appearance of a close net-work, the filaments of which were of a considerable length and thickness, and they seemed to proceed from the thickest part of the liquor. These filaments separated in proportion as the liquor became more fluid; and at last they divided into globules, which seemed at first to have too little force to put them in motion: but their power of moving increased as they receded from the filaments, and they appeared to make considerable efforts to disengage themselves. In this manner each of them gradually drew tails of different lengths out of the filaments. Some of these tails were so long and so thin, that they had no proportion to the bodies, which were always more or less embarrassed, according to the length of the threads or tails. When the tail was long, the angle of the vibratory motion was increased; and, when the tail was short, the progressive motion was more conspicuous.

VIII. I continued my observations, almost without interruption, for 14 hours, and I discovered, that the length of the tails or threads gradually diminished, and became so thin and delicate, that their extremities successively ceased to be visible; at last the whole disappeared. The horizontal vibrations of the globules then ceased, and their progressive motion was direct, though they still had verticle oscillations, or rather, they rolled like a vessel at sea. The small bodies, when deprived of their tails, were oval and transparent, and resembled those pretended animals which are seen in oyster water on the 6th or 7th day, or those found in the jelly of roasted veal at the end of the 4th day.

IX. Between the 10th and 12th hour, the liquor was become very fluid, and all the globules appeared to proceed in troops from one side of the drop. They passed over the field of the microscope in less than four seconds; they marched in lines of seven or eight in front; and succeeded each other without interruption, like the defiling of soldiers. I observed this singular phænomenon for more than five minutes; and, as the current of animals did not then cease, I was desirous of discovering the cause. I therefore gently shifted the glass, and perceived that all these moving globules proceeded from a kind of mucilage, or net-work of filaments, which continually produced them, and with more rapidity and copiousness than the filaments had done ten hours before. There was still a difference more remarkable between the globules produced by the liquor when thick, and those produced when it was more fluid; for, in the latter case, they drew no threads or tails after them, their motion was quicker, and they went in flocks like sheep. I

examined the mucilage from which they proceeded for a long time, and perceived that it gradually diminished and was converted into moving globules, till more than one half of it was destroyed. After which, the liquor being too dry, this mucilage became obscure in the middle, and it was surrounded with small threads, forming square intervals. These small threads seemed to be composed of the bodies of the moving globules which had been killed by the drying of the liquor, and the whole resembled the web of a spider besprinkled with drops of dew.

X. By the first experiments, I perceived that these small moving bodies changed their figures; and I imagined, that, in general, they diminished in bulk, though I was not then altogether certain of the fact. But my subsequent observations removed every doubt. At the 12th and 13th hour, the bodies were visibly smaller; but, as they diminished in bulk, their specific gravity increased, especially when they ceased to move, which they generally did all at once, and fell down to the bottom in the form of an ash-coloured sediment, which was perceptible by the naked eye; and, by the assistance of the microscope, it appeared to be composed of globules attached to one another, sometimes by threads, and at other times in groups, but always in a regular manner.

XI. Having procured the fresh semen of a dog, I observed that this liquor was clear, and had very little tenacity. I examined it without the addition of water, and I perceived moving bodies almost entirely similar to those in the human semen. Their tails and their form were almost precisely the same with those where the liquor had been liquified for two or three hours. I in vain searched this liquor for the filaments which appeared in that of men. I only remarked some long and very delicate threads, exactly similar to those which served for tails to the globules. These threads contained no globules; neither had they any motion. The globules with tails seemed to move with more vivacity than those in the human semen. They had hardly any horizontal vibrations; but they always rolled vertically. Their number was not great; and, though their progressive motion was quicker, they took up some time in passing over the field of the microscope. I examined this liquor during three hours, and could observe no change. I continued my examination, from time to time, for several days, and remarked, that the number of moving bodies gradually diminished. On the second day, the greatest part of them had lost their tails: on the fourth, however, some tails still adhered. The liquor had now deposited a whitish sediment, which appeared to be composed of globules without motion, and some small threads that seemed to be the tails which had separated from the globules. Some globules appeared to have dead ones attached to them; for their figure differed from that of those in motion. They were larger than the moving globules, or the dead ones at the bottom of the liquor, and seemed to have a kind of fissure or opening.

XII. At another time I examined the seminal fluid of the same dog, and perceived the same phænomena which have been described. I farther observed, in a drop of this liquor, a mucilaginous part, from which globules issued as in Exper. IX. and these globules formed a current, and moved in regular troops. This mucilage appeared to be agitated internally with a swelling or undulating motion, which produced small protuberances in different parts; and these protuberances issued suddenly in the form of globules, which moved briskly forward in the same direction. These globules differed not from the others, except that they issued from the mucilage without tails. Some of them, I remarked, changed their figure; they lengthened themselves till they resembled small cylinders: after which the extremities of the cylinders swelled, and divided by the middle into two globules, and both of them moved on in the same direction with the rest.

XIII. The small glass which contained this liquor having been overturned by accident, I took, from the same dog, another quantity of semen. But, whether the animal had been fatigued by too frequent emissions, or from some other cause, this seminal liquor contained nothing: it was transparent and viscous, like the serum of blood; and, though I examined it, at different times, for 24 hours, I could perceive no moving bodies, no mucilage, nor, in a word, any thing similar to what I had formerly seen.

XIV. I then opened a dog, and took out the testicles, and the vessels adhering to them; but I remarked, that he had no seminal vessels: the semen of this animal probably passes directly from the testicles into the urethra. Though the dog was full grown and vigorous, I found very little semen in the testicles. I examined with the microscope the small quantity I could collect; but could perceive no moving bodies; I saw only a great number of very minute globules, the greatest part of which were motionless; and some of the smallest of them seemed to move towards each other. But of this I could not be certain; because the small drops dried in a minute or two after they were put upon the glass.

XV. I cut the testicles of this dog into two parts, put them into a glass-vessel, with as much water as was sufficient to cover them, and corked up the glass. Three days after, I examined this infusion with a view to discover if the flesh contained any moving bodies, and I perceived in the water of this infusion a great number of moving bodies, some of them of a globular, others of an oval figure, and entirely resembling those I had seen in the seminal fluid of the former dog, except that they had no threads or tails: they moved in all directions with great vivacity. I observed, during a long time,

these bodies, which appeared to be animated, and I perceived several of them change their figures before my eyes. Some of them lengthened, others contracted, and others swelled at the two extremities. The whole of them seemed to turn on their centres; some of them were larger, and others smaller; but the whole were in motion, and resembled, both in size and figure, those which were described in Exper. IV.

XVI. Next day, the number of moving globules was still increased; but they were smaller; their motion more rapid and more irregular; and their form and manner of moving were different, and appeared to be more confused: the day after, and the following days, till the 20th, moving bodies still appeared in this water. They daily diminished in size, and at last became so small that they could hardly be perceived; but the last of them I was able to distinguish on the 18th and 20th days, moved with the same rapidity as ever. On the top of the water there was a pellicle which appeared to be composed of the skins or coverings of the moving bodies, of small threads, &c. But no motion appeared in it. This pellicle and the moving bodies could not be introduced into the liquor by means of the external air; for the bottle was always closely corked.

XVII. I opened successively, on different days, ten rabbits, in order to examine their seminal fluid. In the first, second, and third, I found not a single drop, either in the testicles or seminal vessels, though I was certain that two of them were fathers of a numerous progeny. I imagined that the presence of the female might be necessary for the secretion of the semen; I therefore put males and females by pairs into separate cages, so constructed that they could not possibly copulate. Neither did this scheme at first succeed; for I opened two of them without finding any semen. In the sixth, however, which was a large white rabbit, full of vigour, I found as much liquor in the seminal vessels as would fill a small coffee-spoon. This matter resembled the jelly of meat, was of a citron colour, and almost transparent. Having examined it with the microscope, it gradually separated into filaments and large globules, several of which were attached to each other like a string of beads; but I could discover no distinct motion; only, as the matter dissolved, it formed a kind of current, by which the filaments and globules were carried down to one side of the glass. I waited till the matter should become more fluid; but I was disappointed; for, after liquifying a little, it dried up, and I could observe nothing farther than what I have already described. I then added water to it, but without success; for the water seemed not to penetrate or dilute the matter.

XVIII. I opened another rabbit, and found only a small quantity of seminal matter, which had hardly any of the yellow colour, and was more fluid than the former. As the quantity was very small, I was apprehensive lest it should dry too suddenly; I therefore instantly mixed it with water, and could perceive in it neither the filaments nor the strings of beads that I had observed in the other; but I discovered the large globules, and farther remarked, that they had a kind of trembling restless motion. They had also a progressive motion; but it was very slow: some of them moved round others, and most of them appeared to turn round their centres. I could proceed no farther in my observations, because the liquor dried suddenly up.

XIX. Having dissected another rabbit that had been placed in the same circumstances, I found no seminal liquor; but, in the seminal vessels of another, I found nearly as much congealed matter as in Exper. XVII. I examined this matter without discovering any thing. I therefore took the whole, and, adding to it a double quantity of water, shook the mixture violently in a glass. I then left it to settle for ten minutes; after which I examined a drop taken from the surface, and perceived the large globules formerly mentioned; but they were few in number, and perfectly detached from one another. They moved towards each other; but this motion was so slow, as to be hardly perceptible. Two or three hours after, the globules seemed to be diminished in size; their motion was more sensible; and they turned upon their centres. Though their trembling was more apparent than their progressive motion; yet they plainly changed places in an irregular manner, with respect to each other. In six or seven hours, the globules were become smaller, and their activity was greater. Their number appeared to be great, and all their motions were sensible. Next day there was a prodigious multitude of moving globules, and they were at least three times smaller than at first. I continued my observations for eight days, and I perceived that several of the globules joined; and, though all motion ceased after this union, it appeared to be superficial and accidental only. Some of them were larger, and others less; though most of them were spherical, some were oval, and others cylindrical. The largest were most transparent; and the smallest were almost black. This difference could proceed from no accident in the light; for they were always of the same colour, whatever was their situation: the motion of the small globules was likewise more rapid. The whole gradually diminished in size; so that, on the eighth day, they were so small, that it was with the utmost difficulty I could distinguish them, and at last they totally disappeared.

XX. In fine, having, with great difficulty, procured the seminal liquor of another rabbit, in the very state in which it is conveyed into the female, I remarked, that it was much more fluid than that which was extracted from the seminal vessels; and the phænomena it presented were also very different: for, in this liquor there were moving globules, filaments without motion, and a

kind of globules with tails or threads, similar to those in the seminal fluid of man and of the dog, only these last appeared to be less, and more active. They traversed, in an instant, the field of the microscope: their tails seemed to be much shorter than those of other spermatic animals; and I acknowledge, that I was uncertain whether some of these tails were not deceptions occasioned by the track of the globules in the liquor; for they moved with such rapidity, that I could hardly observe them; and besides, the liquor, though sufficiently fluid, dried very suddenly.

XXI. Having procured, at different times, the testicles and seminal vessels of 12 or 13 rams, recently after they were killed, I could not find either in epidydimis or seminal vessels, a quantity of semen sufficient for observation. In the small drops I could collect, I found nothing but globules without motion. As these experiments were made in March, I imagined that, by repeating them in October, which is the time of rutting, I might find more liquor in the vessels. I cut several testicles in two longitudinally, and having collected a small drop of liquor, I still could perceive nothing but motionless globules of different sizes.

XXII. I took three testicles of three different rams, cut them into four parts, and put each of them into a glass-vessel, with as much water as was sufficient to cover them, and then shut the vessels so close as to exclude the air. I allowed the testicles to infuse during four days; after which I examined the liquor in each glass with the microscope, and found the whole full of moving bodies; most of which were oval, and some of them globular. They were equally large, and greatly resembled those described in Exper. VIII. Their motion was not rapid, but equal, uniform, and in all directions. In each liquor, the moving bodies were nearly of the same size; but, in the one they were larger, in the other less, and, in the third, still more minute: they had no tails; neither were there, in the liquor, any threads or filaments. They often changed their figures, and seemed successively to cast their skin or outer covering. They daily became smaller, and, on the 16th day, they were so small as scarcely to be visible.

XXIII. In the following October, I opened a ram, and found a great quantity of seminal liquor in the epidydimis. Having examined it with the microscope, I saw such an innumerable multitude of moving bodies, that the liquor seemed to be entirely composed of them. As the liquor was too thick, I diluted it with water; but I was astonished to find, that the water had stopped all motion in the bodies; though I saw them distinctly in the liquor, they were all at absolute rest. Having frequently repeated the same experiment, I discovered, that cold water, which diluted the seminal liquors of other animals, made that of the ram coagulate.

XXIV. I then opened another ram, and, to prevent the liquor from coagulating by cold, I left the parts of generation in the body of the animal, which was covered with warm cloths. This precaution afforded me an opportunity of examining with ease the seminal liquor of many rams in its fluid state. It was filled with an infinite number of oblong moving bodies, which ran about in every direction. But, whenever the liquor cooled, the motion instantly ceased; so I could never observe the same drop above a minute or two. When I diluted the liquor with warm water, the bodies continued to move for three or four minutes. The moving bodies were so numerous, that, though the liquor was diluted, almost all of them touched each other. They were all of the same size and figure. None of them had tails. Their motion was not rapid; and, when the liquor began to coagulate, they suffered no change in their form.

XXV. As I was persuaded, both by my theory, and the experiments made by others upon this subject, that the female, as well as the male, possessed a prolific seminal fluid; and, as I had no doubt but that the glandulous bodies of the testicles, where prejudiced anatomists had in vain searched for the egg, were the reservoirs of this fluid; I purchased several dogs and bitches, and male and female rabbits, which were kept separate from each other: and that I might have an object to compare with the female fluid, I again examined the seminal liquor of a dog, which had been emitted in the natural manner. I found the moving bodies in the same state, and attended with the same circumstances as formerly.

XXVI. A live bitch was next dissected, which had been four or five days in season, without having any communication with the male. The testicles were as large as filberds. On one of them I found a red prominent glandulous body of the size of a pea, which had a perfect resemblance to a little nipple, with a visible fissure, that had two lips, one of which was more prominent than the other. Having opened this fissure, a liquor distilled from it, which we collected for examination. The testicles were then returned into the body of the animal, which was still alive, in order to preserve them from cooling. I then examined this liquor with the microscope, and had the satisfaction of perceiving, at the first glance, moving bodies with tails, exactly similar to those which we had observed in the seminal fluid of the dog. Messrs. Needham and Daubenton, who were present, were so struck with this resemblance, that they could not be persuaded that the spermatic animals were not the very same; and they imagined that I had forgotten to change the object-glass, or rather, that the same pick-tooth with which the drops of the female fluid were collected, had also been employed in collecting those of the male. Mr. Needham, therefore, changed both the object-glass and the pick-tooth, and took a fresh drop from the fissure of the glandulous body, and

examined it first with his own eyes. He again saw the very same moving bodies, and was fully convinced, not only of the existence of spermatic animals in the seminal fluid of the female, but also of their resemblance to those in the semen of the male. We repeated the experiment with fresh drops no less than ten times, in all of which the phænomena were exactly the same.

XXVII. Having then examined the other testicle, I found an unripe glandulous body, which was smaller, and less red than the former, and had no fissure; but, after opening it with a scalpel, I found no liquor. Upon the external surface of this testicle, there were some lymphatic vesicles. I pierced one of them with a lancet, and there issued a clear liquor, to which I immediately applied the microscope. But it contained nothing similar to what we discovered in that of the glandulous body. It was a transparent liquor, composed of very small globules, without any motion. After repeating this experiment several times, I was convinced, that the liquor in the vesicles is only a species of lymph, which contains nothing animated or similar to what we perceive in the female semen, which is secreted and matured in the glandulous bodies.

XXVIII. Some time after, another bitch was opened which had been seven or eight days in season, and had not received the male. I examined the testicles, and upon each I found a glandulous body in full perfection. The first was half open, and had a canal which penetrated the testicle, and was full of seminal fluid; the second was larger and more prominent, and the fissure or canal that contained the fluid was below the nipple, which protruded outward. I took the liquor out of both the glandulous bodies, and, on comparison, found them entirely similar. This seminal liquor of the female is equally fluid with that of the male. After examining the liquors extracted from each testicle, I found in them the very same moving bodies. I perceived at leisure the same phænomena that I had observed in the seminal liquor of the other bitch; I saw several globules which moved with great rapidity, which endeavoured to disengage themselves from the mucilage that surrounded them, and which dragged tails or threads after them. Their number was equally great with that in the male semen.

XXIX. I squeezed the whole liquor out of these two glandulous bodies, and put it into the glass of a watch. The quantity was sufficient to serve for four or five hours observation. I remarked that it deposited a kind of sediment, or at least began to thicken. I took a drop of the thickest part of the liquor, and having examined it, I discovered that the mucilaginous part of the semen was condensed, and formed a kind of net-work. From the anterior edge of this net-work, there issued a current of globules which moved with great rapidity. These globules were extremely active and lively, and they appeared to be divested of their mucilaginous coverings and of their tails. This stream of globules resembled the motion of the blood in the veins; for they seemed not only to be animated, but to be pushed on by some common force, which obliged them to follow each other in troops or rows. From this experiment, and from the 11th and 12th, I concluded, that, when the fluid begins to coagulate or grow thick, the active globules break their mucilaginous covering, and escape at that side where the liquor is most fluid. They had no threads or tails, and most of them were oval, and seemed to be flat below; for they had no rolling motion.

XXX. I opened the horns of the uterus longitudinally, and having squeezed a little liquor out of them, I found it exhibited precisely the same phænomena with that obtained from the glandulous bodies. These glandulous bodies are so situated, that they can easily pour their liquor upon the horns of the uterus: and I am persuaded that, during the whole season of love there is a perpetual distillation of this liquor from the glandulous bodies into the horns of the uterus; that this distillation continues till the glandulous bodies be entirely emptied; and that they are gradually effaced, leaving only behind them a small reddish cicatrice on the external surface of the testicle.

XXXI. I mixed the seminal liquor of the female with an equal portion of that of the male, which was recently emitted; but the moving bodies, and every circumstance, were so entirely the same, that I could make no distinction between those of the male and those of the female.

XXXII. Having dissected a young bitch that had never been in season, I discovered on one of the testicles only, a small solid protuberance, which I imagined to be the rudiments of a glandulous body. The surface of the testicles was smooth and uniform, and it was with difficulty I could see the lymphatic vesicles, till the membranes which cover the testicles were removed. The small quantity of liquor that was squeezed from the testicles contained no moving bodies.

XXXIII. In another bitch still younger, there was no appearance of glandulous bodies on the testicles; their surface was white and perfectly smooth. Some small vesicles were discovered; but they seemed to contain no liquor. I compared these female testicles with those of a male of the same age, and found that their internal texture, which was fleshy, was nearly of the same nature.

XXXIV. I procured the uterus of a cow that had been recently killed. It was brought to me in a basket, wrapped in warm cloths, along with a live rabbit, to preserve it from cooling. The testicles were as large as a small hen's egg; on one of them was a glandulous body of the size of a pea, which protruded from the testicle like a little nipple: but it had no fissure or external aperture. It was so firm and hard, that I could press no liquor out of it with my fingers. Before cutting this

testicle, I observed two other glandulous bodies at a distance from each other. They were very small, and of a whitish yellow colour; but the large one, which seemed to have pierced the membrane of the testicle, was as red as a rose. I examined this last with great attention, but could discover no liquor; from which I concluded, that it was still far from being mature.

XXXV. In the other testicle, there were no glandulous bodies which had yet pierced the membrane that covers the testicle. Two small ones only began to appear under the membrane. I opened them both; but procured no liquor from them. They were hard bodies, with a tincture of yellow. On each testicle there were four or five lymphatic vesicles; they were full of liquor. When examined with the microscope, some small globules appeared; but there was not in them the least vestige of motion. I observed this liquor, from time to time, for two days, without discovering any thing new.

XXXVI. I had two other uteri conveyed to me in the same manner. The one belonged to a young cow that had never brought forth; the other to a cow which, though not old, had had several young. I first examined the testicles of the latter, and found, upon one of them, a glandulous body as large as a cherry. I perceived three holes into which bristles might be introduced. Having pressed the body with my fingers, a small quantity of liquor issued out, which I examined, and had the pleasure of seeing moving bodies, but different from what I had observed in other seminal fluids. These globules were small and obscure: their progressive motion, though distinct, was very slow. The liquor was not thick: the moving globules had no appearance of threads or tails, and they were not all in motion. These are all the observations I could make on this liquor; for, though I again squeezed the glandulous body, I could not obtain any more liquor that was unmixed with blood. The moving bodies were at least a fourth part less than the globules of the blood.

XXXVII. This glandulous body was situated at one extremity of the testicle, near the horn of the uterus; and the liquor which it distilled must have fallen upon that horn: but, after opening the horn, I found no liquor. I then opened the testicle longitudinally, and, though its cavity was sonsiderable, it contained no fluid. At some distance from the large glandulous body, there was a small one of the same kind, about the size of a lentil. Two cicatrices, or little pits, also appeared; they were of a deep red colour, and were the relics of old glandulous bodies which had been obliterated. Having next examined the other testicle of the same cow, I discovered four cicatrices and three glandulous bodies, the most advanced of which was of a red flesh-colour, and exceeded not the size of a pea. It was solid, without any aperture, and contained no liquor. The other two were much smaller and harder; and their colour was a kind of orange. The lymphatic vesicles were full of a clear liquid; but contained nothing that had the appearance of life.

XXXVIII. I then inspected the testicles of the young cow, which had never brought forth. They were rather larger than those of the other cow; but, what is not less remarkable than true, there was not a single cicatrice on either of them. A number of lymphatic vesicles appeared on one of the testicles; but there was no vestige of glandulous bodies. Upon the other testicle, I could discern the rudiments of two glandulous bodies, one just beginning to spring up, the other as large as a small pea. There were also many vesicles, which appeared, after being pierced with a lancet, to contain nothing. The glandulous bodies, when opened, gave forth nothing but blood.

XXXIX. I cut each testicle of both cows into four parts, and, having put them into separate vials, I poured as much water upon them as was just sufficient to cover them; and, after corking the vials close, I allowed them to infuse for six days. I then examined the infusions with the microscope, and saw an amazing number of moving globules. In all the infusions, the globules were extremely small, but very active, moving with rapidity round their centres, and in all directions. I observed them, from time to time, during three days, and they always became smaller and smaller, till they totally disappeared on the third day.

XL. I procured the uteri of three other cows. I first searched the testicles in order to discover if there were any mature glandulous bodies. In two of the uteri I found only small glandulous bodies on the testicles. I was not informed whether the cows had ever brought forth; but it is probable that they had often been in season; for a number of cicatrices appeared on their testicles. On one of the testicles of the third cow, I observed a glandulous body as large as a cherry, and very red; it was much swelled, and seemed to be perfectly ripe. I pressed the nipple, which was perforated by a hole, with my fingers, and a considerable quantity of liquor issued out. In this liquor, I found moving bodies perfectly similar to those described in Ex. XXXVI. Their number was indeed greater, and their progressive motion was quicker; they seemed to be somewhat longer; and, having observed them a long time, I perceived that they grew longer, and changed their figure. I then introduced a fine probe into the small aperture of the glandulous body; and, having cut along the probe as a directory, I found that the cavity was filled with a liquid matter. This liquor, when examined with the microscope, presented the same phænomena, the same moving bodies, as in Exper. XXXVI. But I could discover in none of them either filaments or tails. The liquor of the vesicles was still transparent, and contained nothing like life or motion.

XLI. The uteri of several other cows were brought to

me at different times. In the testicles of some of them, there were glandulous bodies almost ripe; in those of others, they were in different states of growth; and I perceived nothing new or uncommon, except that I discovered, in the testicles of two of them, glandulous bodies in a decayed state, the base of one of which was as large as the circumference of a cherry. The extremity of the nipple was soft and withered: the two small holes through which the fluid had issued were still visible. I introduced a small bristle into them; but there was no liquor either in the canal, or in the internal cavity, which could still be distinguished. The extinction of the glandulous bodies, therefore, commences at the most external part, or extremity of the nipple. They first diminish in height, and then in breadth, as I had an opportunity of observing in another testicle, where there was a glandulous body diminished about three fourths.

XLII. As the testicles of female rabbits, as well as their glandulous bodies are very minute, I could make no exact experiments on their seminal liquor. I only discovered, that the testicles of different females are in different states; and that I never saw any of them which exactly resembled De Graaff's figures.

XLIII. On the testicles of some cows, I found a species of bladders or vesicles, which are called *hydatides* by anatomists. I observed some of them large and others small; and they were attached to the testicle by a kind of pedicle. I examined the liquor they contained; but it was transparent, homogeneous, and every way similar to the liquor in the vesicles. It had no globular or moving particles.

XLIV. At this time, I made some experiments upon oyster-water, upon water in which pepper had been boiled, upon water in which pepper had been simply infused, and upon water in which pink-seeds were infused. The bottles containing all these infusions were exactly corked. At the end of two days, I saw, in the oyster-water, a vast quantity of oval and globular bodies, which seemed to swim like fishes in a pond, and had every appearance of being real animals. They had no members that could be discovered, and no tails. They were transparent, and pretty large; I saw them change their figures; they became gradually smaller and smaller during the seven or eight days that they existed; and, lastly, along with Mr. Needham, I saw animalcules so very similar, in an infusion of the jelly of roasted veal, which had likewise been close corked, that I am persuaded they are not true animals, agreeable to the common acceptation of that term, as shall afterwards be fully explained.

The infusion of pink-seeds was crowded with innumerable moving globules, which appeared to be equally animated with those in the seminal liquors and infusions of flesh. At first they were pretty large, and moved with great rapidity in every possible direction. They continued in this state during three weeks, and gradually diminished in size till their minuteness rendered them invisible.

The same phænomenon took place in the infusions of pepper; but the moving bodies did not appear so early as in the other infusions, and their appearance was later in the infusion of pepper that was not boiled. I then began to suspect that what is called fermentation, might be owing to the motion of these organic particles in animal and vegetable substances. To discover if there were any similarity between this species of fermentation, and that excited by mineral substances, I applied to the microscope a little lime-stone powder, and poured upon it a drop of aqua-fortis. But the phænomena were totally different. Large bubbles rose to the surface, and instantly darkened the lens of the microscope; when the gross parts were dissolved, every thing remained at rest, and nothing appeared which had the smallest analogy to what we perceive in the infusions of animal or vegetable substances.

XLV. I examined the seminal liquor in the milts of different fishes, extracted while the animals were alive; and I observed a vast quantity of obscure moving globules. I then squeezed with my fingers the aperture in the bellies of fishes through which they emit this liquor; and, in the drops which I procured, I saw great multitudes of the same moving globules, which were almost black, and very small.

XLVI. Before I conclude this chapter, I shall relate the experiments of Mr. Needham upon the semen of a species of cuttle-fish, called the *Calmar*. This acute observer, having examined the spermatic animals in the milts of different fishes, found them of an uncommon magnitude in the milt of the calmar. To the naked eye, they were from three to four lines in length. During a whole summer, while he dissected calmars at Lisbon, he could find no appearance of a milt, or of any reservoir destined to receive the seminal liquor of that fish; and it was the middle of December before he could perceive the first vestiges of a new vessel filled with a milty juice. This reservoir, and the juice it contained, gradually increased. In examining this seminal liquor with the microscope, he saw nothing in it but small opaque globules swimming in a kind of serous matter, without any appearance of life. But, some time after, he discovered, in the milt of another calmar, organic bodies completely formed, which resembled spiral springs, inclosed in a transparent case. These springs were equally perfect at the first observation as afterwards; only they, in time, contracted themselves, and formed a kind of screw. The head of the case is a species of valve which opens outward, and through which every thing within may be forced out. It contains, besides, another valve, a little barrel, and a spongy substance. Thus the whole machine consists of an

outer, transparent, cartilaginous case, the superior extremity of which is terminated by a round head, formed by the case itself, and performs the office of a valve. This external case contains a transparent tube, which includes the spring, a piston or valve, a little barrel, and a spongy substance. The screw occupies the superior part of the tube and case, the piston and barrel are situated in the middle, and the spongy substance occupies the inferior part. These machines pump the liquor of the milt; the spongy substance is full of this liquor; and, before the animal spawns, the whole milt is only a congeries of these organic bodies, which have absolutely pumped up and dried the milty liquor. Whenever these small machines are taken from the body of the animal, and put among water, or exposed to the air, they begin to act: the spring mounts up, and is followed by the piston, the barrel, and the spongy substance which contains the liquor: and, as soon as the spring and the tube in which it is contained begin to issue out of the case, the spring plaits, and the whole internal apparatus moves, till the spring, the piston, and the barrel, have entirely escaped from the case. When this is effected, all the rest instantly follow, and the milty liquor, which had been pumped, and was confined in the spongy substance, runs out through the barrel.

As this phænomenon is extremely singular, and incontestibly proves that the moving bodies in the milt of the calmar are not real animals, but simple machines, a species of pumps, I shall here transcribe Mr. Needham's own account of the matter:

'When the small machines,' says he, 'have come to 'their full maturity, several of them act as soon as they 'are exposed to the air. Most of them, however, may 'be commodiously viewed by the microscope before their 'action commences; and, even before they act, it is ne-'cessary to moisten with a drop of water the superior 'extremity of the external case, which then begins to 'expand, while the two slender ligaments that issue out 'of the case are twisted and contorted in different ways. 'At the same time, the screw rises slowly, and the spirals 'at its superior end approach each other, and act against 'the top of the case, those which are lower seeming to 'be continually followed by others that issue from the 'piston; I say, that they *seem* to follow; because I be-'lieve it to be only a deception produced by the motion 'of the screw. The piston and barrel likewise move in 'the same direction; and the inferior part, which con-'tains the semen, extends in length, and, at the same 'time, moves towards the top of the case, which is ap-'parent by the vacuity left at the bottom. As soon as 'the screw, with the tube in which it is inclosed, begins 'to appear out of the case, it twists, because it is con-'strained by the two ligaments. The whole internal 'apparatus continues to move gradually and slowly till 'the screw, the piston, and the barrel, have entirely 'escaped. When that happens, the remainder issues 'instantaneously. The piston, separates from the 'barrel; the ligament, which is under the barrel, swells 'and acquires a diameter equal to that of the spongy 'part which succeeds it: this, though much broader 'than when in the case, becomes also five times longer 'than formerly. The tube, which included the whole, 'contracts in the middle, and forms two knots or joints, 'distant about one third of its length from each extre-'mity. Then the semen escapes by the barrel. It is 'composed of small opaque globules, which swim in a 'serous matter, without discovering any signs of life, 'and are precisely the same as I perceived them to be 'when diffused through the reservoir of the milt. The 'part comprehended between the two joints, appears to 'be fringed. When examined attentively, this appear-'ance seems to be occasioned by the spongy substance 'within the tube being broken and divided into portions 'nearly equal. The following phænomena will clearly 'prove that this is the case.

'It sometimes happens, that the screw and the tube 'break precisely above the piston, which remains in the 'barrel. Then the tube instantly shuts; and, by con-'tracting, assumes a conical figure above the extremity 'of the screw. This is a demonstration that it is there 'very elastic; and the manner in which it accommodates 'its figure to that of the substance which includes it, 'when the latter undergoes the smallest change, proves 'that it is every where equally elastic.'

Mr. Needham hence concludes, that it is natural to imagine that the total action of this machine is occasioned by the spring of the screw. But, unfortunately, he proves, by several experiments, that the screw is acted upon by a power residing in the spongy part: as soon as the screw is separated from the rest of the machine, it ceases to act, and loses all motion. The author draws the following conclusion from this singular phænomenon.

'If I had seen,' says he, 'these pretended animalcules 'in the semen of living animals, I should, perhaps, 'have been able to ascertain whether they are really 'animated beings, or only prodigiously small machines, 'which correspond in miniature to the larger vessels of 'the calmar.'

From this and other analogies, Mr. Needham concludes, that the spermatic worms of other animals, it is reasonable to think, are only organic bodies; a species of machines similar to those of the calmar, which act at different times; for, says he, if we suppose that, of the prodigious number of spermatic animalcules which appear in the field of the microscope, only a few thousands act a time, this will be sufficient to make us believe the whole to be alive. If it be farther supposed, he adds, that the motion of each animalcule lasts, like that of the calmar machines, about half a minute; in this case, the

successive action of the small machines would continue for a considerable time, and the animalcules would die one after another. Besides, why should the semen of the calmar alone contain machines, while that of all other animals contains real living animalcules? Here the analogy is so strong as to be almost irresistible. Mr. Needham farther remarks, that even Leeuwenhoek's experiments seem to indicate that the spermatic animals have a great resemblance to the organic bodies in the semen of the calmar. Speaking of the semen of the cod, Leeuwenhoek remarks, that he imagined the oval bodies to be animalcules burst and distended, because they were four times larger than when alive. And, in another place, he observes of the semen of a dog, that the animalcules often changed their figure, especially when the liquor began to evaporate.

On all these accounts, Mr. Needham conjectured, that the pretended spermatic animals were only a kind of natural machines, bodies much more simply organized than those of real animals. I examined the machines of the calmar along with him, and the reader may be assured that his description of them is both exact and faithful. His experiments, therefore, demonstrate, that the seminal fluid consists of particles in quest of organization; that, in fact, it produces organized bodies; but that these bodies are not animals, nor similar to the individual which produces them. It is indeed, probable, that these organized bodies are only a kind of instruments for perfecting the semen, and bestowing on it an active force; and that it is by their internal action that they intimately penetrate the seminal fluid of the female.

CHAPTER VII.

Comparison of my own Experiments with those of Leeuwenhoek.

THOUGH my experiments were made with all the attention of which I was capable, and though I often repeated them, I am satisfied that many things must have escaped me. I have described only what I saw, and what every man may see, at the expence of a little art and patience. To free myself from prejudice, I even attempted to forget what other observers pretended to have seen, endeavouring, by this means, to be certain of seeing nothing but what really appeared; and it was not till I had digested my experiments, that I wished to compare them with those of former writers, and particularly with those of Leeuwenhoek, who had occupied himself more than 60 years in experiments of this kind.

Whatever authority may be due to this acute observer, it is certainly allowable to institute a comparison between a man's own observations, and those of the most respectable writer on the same subject. By an examination of this kind, truth may be established, and errors may be detected, especially when the only object of inquiry is to ascertain the genuine nature of those moving bodies which appear in the seminal fluids of all animals.

In the month of November, 1677, Leeuwenhoek, who had formerly communicated many microscopic observations to the Royal Society of London, concerning the juices of plants, the texture of trees, the optic nerve, rain water, &c. writes to Lord Brouncker, president of the Society, in the following terms: Postquam Exc. Domi-
'nus Professor Cranen me visitatione sua sæpius hono-
'rarat, litteris rogavis Domino Ham cognato suo, quas-
'dam observationum mearum videndas darem. Hic
'Dominus Ham me secundo invisens, secum in lagun-
'cula vitrea semen viri, gonorrhœa laborantis, sponte
'destillatum, attulit, dicens, se post paucissimas tem-
'poris minutas (cum materia illa jam in tantum esset
'resoluta ut fistulæ vitreæ immitti posset) animalcula
'viva in eo observasse, quæ caudam et ultra 24 horas
'non viventia judicabat: idem referebat se animalcula
'observasse mortua post sumptam ab ægroto therebin-
'tinam. Materiam prædicatam fistulæ vitræe immissam,
'præsente Domino Ham, observavi, quasdamque in ea
'creaturas viventes, ac post decursum 2 aut 3 horarum
'eamdem solus materiam observans, mortuas vidi.

'Eamdem materiam (semen virile) non ægroti ali-
'cujus, non diuturna conservatione corruptam, vel post
'aliquot momenta fluidiorem factam, sed sani viri statim
'post ejectionem, ne interlabentibus quidem sex arteriæ
'pulsibus, sæpiuscule observavi, tantamque in ea viven-
'tium animalculorum multitudinem vidi, ut interdum
'plura quam 1000 in magnitudine arenæ sese moverent;
'non in toto semine, sed in materia fluida crassiori ad-
'hærente, ingentem illam animalculorum multitudinem
'observavi; in crassiori vero seminis materia quasi sine
'motu jacebant, quod inde provenire mihi imaginabar,
'quod materia illa crassa ex tam variis cohæreat par-
'tibus, ut animalcula in ea se movere nequirent; minora
'globulis sanguini ruborem adferentibus hæc animalcula
'erant, ut judicem, millena millia arenam grandiorem
'magnitudine non æquatura. Corpora eorum rotunda,

'anteriora obtusa, posteriora ferme in aculeum desinentia 'habebant; cauda tenui longitudine corpus quinquies 'sexiesve excedente, et pellucida, crassitiem vero ad 25 'partem corporis habente, prædita erant, adeo ut ea 'quo ad figuram cum cyclaminis minoribus, longam 'caudam habentibus, optime comparare queam: motu 'caudæ serpentino, aut ut anguillæ in aqua natantis, 'progrediebantur; in materia vero aliquantulum crassi- 'ori caudam octies deciesve quidem evibrabant ante- 'quam latitudinem capilli procedebant. Interdum ima- 'ginabar me internoscere posse adhuc varias in corpore 'horum animalculorum partes, quia vero continuo eas 'videre nequibam, de iis tacebo. His animalculis mi- 'nora adhuc animalcula, quibus non nisi globuli figu- 'ram attribuere possum, permista erant.

'Memini me, ante tres aut quatuor annos, rogatu 'Domini Oldenburg, B. M. semen verile observasse, et 'prædicta animalia pro globulis habuisse; sed quia fas- 'tidiebam ab ulteriori inquisitione, et magis quidem a 'descriptione, tunc temporis eam omisi. Jam quoad 'partes ipsas, ex quibus crassam seminis materiam, 'quoad majorem sui partem consistere sæpius cum ad- 'miratione observavi, ea sunt tam varia ac multa vasa, 'imo in tanta multitudine hæc vasa vidi, ut credam me 'in unica seminis gutta plura observasse quam anato- 'mico per integrum diem subjectum aliquod secanti 'occurrant. Quibus visis, firmiter credebam nulla in 'corpore humano jam formato esse vasa, quæ in semine 'virili bene constituto non reperiantur. Cum materia 'hæc per momenta quædam aeri fuisset exposita, præ- 'dicta vasorum multitudo in aquosam magnis oleagi- 'nosis globulis permistam materiam mutabatur,' &c.

The secretary of the Royal Society replied to this letter of Leeuwenhoek, that it would be proper to make similar experiments on the seminal fluids of other animals, not only to support the original discovery, but to distinguish whatever differences might appear in the number and figure of the animalcules: and, with regard to the vascular texture of the thick part of the seminal fluid, he suspected that it was only a congeries of filaments, without any regular organization: 'Quæ tibi 'videbatur vasorum congeries, fortassis seminis sunt 'quædam filamenta, haud organice constructa, sed dum 'permearunt vasa generationi inservientia in istiusmodi 'figuram elongata. Non dissimili modo ac sæpius no- 'tatus sum salivam crassiorem ex glandularum faucium 'foraminibus editam, quasi e convolutis fibrillis con- 'stantem.'

Leeuwenhoek replied, 18th March, 1678, in the following words: 'Si quando canes cœunt marem a fœmina 'statim seponas, materia quædam tenuis et aquosa '(lympha scilicet spermatica) a pene solet paulatim ex- 'stillare; hanc materiam numerosissimis animalculis 'repletam aliquoties vidi, eorum magnitudine quæ in 'semine virili conspiciuntur, quibus particulæ globu- 'lares aliquot quinquagies majores permiscebantur.

'Quod ad vasorum in crassiori seminis virilis portione 'spectabilium observationem attinet, denuo non semel 'iteratam, saltem mihimetipsi comprobasse videor; 'meque omnino persuasum habeo, cuniculi, canis, felis, 'arterias venasve fuisse a peritissimo anatomico haud 'unquam magis perspicue observatas, quam mihi vasa 'in semini virili, ope perspicilli, in conspectum venere.

'Cum mihi prædicta vasa primum innotuere, statim 'etiam pituitam, tum et salivam perspicillo applicavi; 'verum hic minime existentia animalia frustra quæsivi.

'A cuniculorum coitu lymphæ spermaticæ guttulam 'unam et alteram, e femella extillantem, examini sub- 'jeci, ubi animalia prædictorum similia, sed longe pau- 'ciora, comparuere. Globuli item quam plurimi, pleri- 'que magnitudine animalium, iisdem permisti sunt.

'Horum animalium aliquot etiam delineationes trans- 'misi; exprimit eorum aliquot vivum (in semine cuni- 'culi arbitror) æque forma qua videbatur, dum aspicien- 'tem me versus tendit. Capitulum cum trunco indi- 'cant; ejusdem caudam, quam pariter ut suam anguillæ 'inter natandum vibrat. Horum millena millia, quan- 'tum conjectare est, arenulæ majoris molem vix super- 'ant. Sunt ejusdem generis animalia, sed jam emortua.

'Delineatur vivum animalculum quemadmodum in 'semine canino sese aliquoties mihi attentius intuenti 'exhibuit. Caput cum trunco indigitant, ejusdem 'caudam. Alia sunt in semine canino quæ motu et vita 'privantur, qualium etiam vivorum numerum adeo in- 'gentem vidi, ut judicarem portionem lymphæ sperma- 'ticæ arenulæ mediocri respondentem, eorum ut mini- 'mum decena millia continere.'

In another letter to the Royal Society, dated May 31, 1678, Leeuwenhoek adds, 'Seminis canini tantillum mi- 'croscopio applicatum iterum contemplatus sum, in 'eoque antea descripta animalia numerosissime conspexi. 'Aqua pluvialis pari quantitate adjecta, iisdem confestim 'mortem accercit. Ejusdem seminis canini portiuncula 'in vitreo tubulo unciæ partem duodecimalem crasso 'servata, sex et triginta horarum spatio contenta ani- 'malia vita destituta pleraque, reliqua moribunda vide- 'bantur.

'Quo de vasorum in semine genitali existentia magis 'constaret, delineationem aliqualem mitto, quibus literis 'circumscriptum spatium arenulam mediocrem vix su- 'perat.'

I have transcribed these passages from the Philosophical Transactions, because they first appeared in that work, before Leeuwenhoek had formed any theory; and, therefore, they must be more agreeable to truth. After the ingenious author had formed a system of generation, his account of the spermatic animals varies, even in essential articles.

In the first place, what he says concerning the number of these pretended animalcules is true; but the figure of their bodies corresponds not always to his description. Sometimes the end next the tail is globular, and sometimes cylindrical; sometimes it is flat, and at other times it is broader than long, &c. With regard to the tail, it is often thicker and shorter than he represents. The vibratory motion he ascribes to the tail, and by which he alledges the animals are enabled to proceed forward, I never could distinguish in the manner he describes. I have seen these moving bodies vibrate eight or ten times, from right to left, or from left to right, without advancing the breadth of a single hair; and I have observed many of them which never could proceed forward, because this tail, in place of assisting them to swim, was, on the contrary, a small thread attached to the filaments or mucilaginous part of the liquor, and, of course, totally prevented the progressive motion of the body. Even when the tail appeared to have any motion, it resembled only the small bendings of a thread at the end of a vibration. I have seen these threads or tails fixed to the filaments, which Leeuwenhoek calls vessels: I have seen them separate from the filaments, after repeated efforts made by the moving bodies: I have seen them first long, then diminish, and at last disappear. Thus these tails ought to be regarded as accidental appendages, and not as real members of the moving bodies. But, what is more remarkable, Leeuwenhoek expressly affirms, in his letter to Lord Brouncker, that, besides the tailed animals, he observed in this liquor animalcules still more minute that had no tails, and were perfectly globular: 'His animalculis (caudatis 'scilicet) minora adhuc animalcula, quibus non nisi 'globuli figuram attribuere possum, permista erant.' This is the truth. After Leeuwenhoek, however, had maintained that these animalcules were the only efficient principle of generation, and that they were transformed into men, he regards as real animals those only which had tails; and, accordingly, as it was necessary that animalcules, to be transformed into men, should have a constant and invariable figure, he never afterwards mentions the round animals without tails. I was struck with the difference between the original composition of this letter, and the form in which it appeared twenty years afterwards in his third volume: for, instead of the words which we have just now quoted, we meet with the following in page 63. 'Animalculis hisce per-'mistæ jacebant aliæ minutiores particulæ, quibus non 'aliam quam globulorum seu sphæricam figuram assig-'nare queo.' This is a very different account of the matter. A particle of matter, to which he ascribes no motion, is extremely different from an animalcule. It is astonishing that Leeuwenhoek, in copying his own letter, should have changed an article of so much consequence. What he immediately subjoins likewise merits attention. He says, that, at the intreaty of Mr. Oldenburg, he had examined this liquor three or four years ago; and that he then imagined these animalcules to be globules. Thus, these pretended animalcules are sometimes globules without any sensible motion; some times they are globules which move with great activity; sometimes they have tails, and sometimes no tails.

Secondly, It is worthy of remark, that Leeuwenhoek had very early discovered the filaments which appear in the semen before it be liquified; and that, at that time, when he had not conceived his hypothesis concerning the spermatic animals, he imagined the filaments to be veins, nerves, and arteries. He firmly believed, that all the parts and vessels of the human body might be clearly distinguished in the seminal fluid. He even persisted in this opinion, notwithstanding the representations made to him by Mr. Oldenburg, in the name of the Royal Society. But, after he conceived the notion of transforming his spermatic animals into men, he never again takes any notice of these vessels. Instead of regarding them as the nerves and blood-vessels of the human body already formed in the semen, he does not even ascribe to them their real function, which is the production of the moving bodies.

Thirdly, It may fairly be concluded, that Leeuwenhoek has not always seen the same phænomena; that the moving bodies, which he regards as animals, have appeared to him under different forms; and that he has contradicted himself with a view to make the species of men and of animals uniform and consistent. He not only varies as to the fundamental part of these experiments, but also as to the manner of making them; for he expressly tells us, that he always diluted the semen with water to separate its parts, and to give more freedom of motion to the animalcules; and yet, in his first letter to Lord Brouncker, he says, that, when he mixed the semen of dogs, in which he before had seen innumerable animals, with water, they all instantly died. Thus Leeuwenhoek's first experiments were made, like mine, without any mixture; and it appears, that he was not in use to mix the liquor with water till long after he began his experiments, and till he conceived the idea that water killed the animalcules; which, however, is not true. I imagine, that the addition of water only dissolves the filaments too suddenly; for, in all my experiments, I have seen but very few filaments in the liquor, after its being mixed with water.

Leeuenhoek was no sooner persuaded that the spermatic animalcules were transformed into men and other animals, than he imagined that he saw two distinct kinds in the semen of every animal, the one male, and the other female. Without this difference of sex in the spermatic animalcules, it was difficult, he says, to conceive the possibility of producing males and females by simple transformation. He mentions these male and

female animalcules in his letter published in the Philosophical Transactions, No. 145, and in several other places. But he attempts not to describe the differences between the male and female animalcules, which never existed but in his own imagination.

It appears, that Leuwenhoek's observations, though he draws very different conclusions from them, perfectly correspond with mine: and, though there be some opposition in the facts, I am fully persuaded, that, whoever shall take the trouble of repeating the experiments, will easily discover the source of these differences, and find that I have related nothing but truth. To enable the reader to decide in this matter, I shall add a few remarks.

We do not always see in the human semen, the filaments I have mentioned; for this purpose the liquor must be examined the moment it is extracted from the body: and even then they do not uniformly appear. When the liquor is too thick, it presents nothing but large globules, which may be distinguished with a common lens. When examined with the microscope they have the appearance of small oranges; they are very opaque, and one of them occupies the whole field of the microscope. The first time I observed these globules, I imagined them to be foreign bodies which had fallen into the liquor. But, after examining different drops, I found that the whole liquor was composed of these large globules. I observed one of the largest and roundest of them for a long time. At first it was perfectly opaque: a little after, I perceived on its surface, about half way between the centre and circumference, a beautiful coloured luminous ring, which continued more than half an hour, then gradually approached the centre, which became clear and coloured, while the rest of the globule remained opaque. This light, which illuminated the centre, resembled that which appears in large air-bubbles. The globule now began to grow flat, and to have a small degree of transparency: and, after observing it for three hours, I could perceive no other change, no appearance of motion, either internal or external. I imagined that some change might happen by mixing the liquor with water. The globules were indeed changed into a transparent homogeneous fluid, which presented nothing worthy of remark. I left the semen to liquify of of its own accord, and examined it at the distance of 6, 12, and 24 hours; but found nothing like life or motion. I relate this experiment to show, that the ordinary phænomena are not always to be expected in seminal fluids, though they be apparently similar.

Sometimes all the moving bodies have tails, especially in the semen of a man, and of the dog; their motion is not then very rapid, and appears to be performed with difficulty. If the liquor be allowed to dry, the tails or threads are first deprived of motion; the anterior extremity continues to vibrate for some time, and then all motion ceases. These bodies may be long preserved in this state; and, if a small drop of water be then poured upon them, their figure changes; they fall down into several minute globules, which appear to have a small degree of motion, sometimes approaching each other, and sometimes trembling, and turning round their centres.

The moving bodies in human semen, and in those of the dog and bitch, resemble each other so strongly, that it is not easy to distinguish them, especially when examined immediately after they are taken from the body of the animal. Those of the rabbit appear to be smaller and more active. But these differences and resemblances proceed more from the different states of the fluids during the time of examination, than from the nature of the fluids themselves, which ought indeed to be different in different species of animals: for example, in the human fluid, I have remarked large filaments, and I have seen the moving bodies separate from these filaments, from which they appeared to derive their origin. But I could perceive nothing of this kind in the semen of the dog. Instead of distinct filaments, it is generally composed of a compact mucilage, in which we with difficulty perceive some filamentous parts; and yet this mucilage gives birth to moving bodies similar to those in the human semen.

The motion of these bodies continues longer in the fluid of the dog, than in that of man, which enables us more easily to distinguish the change of form above remarked. The moment the fluid issues from the body of the animal, we find most of the animalcules possessed of tails. In 12, 24, or 36 hours afterwards, almost the whole tails disappear; we then perceive only oval bodies moving about, and generally with more rapidity than at first.

The moving bodies are always below the surface of the liquor. Several large transparent air-bubbles commonly appear on the surface; but they have no motion, unless when the liquor is agitated. Below the moving bodies we often perceive others still more minute: these have no tails, but most of them move; and, in general, I have remarked, that, of the numberless globules in all these liquors, the smallest are generally blacker and more obscure than the others; and that those which are extremely minute and transparent have little or no motion. They seem likewise to have more specific gravity; for they are always sunk deepest in the fluid.

CHAPTER VIII.

Reflections on the preceding Experiments.

FROM the foregoing experiments, it appears, that females, as well as males, have a seminal fluid containing bodies in motion; that these moving bodies are not real animals, but only organic living particles; and that these particles exist not only in the seminal fluids of both sexes, but in the flesh of animals, and in the seeds of vegetables. To discover whether all the parts of animals and all the seeds of plants contained moving organic particles, I made infusions of the flesh of different animals, and of the seeds of more than twenty different species of vegetables; and, after remaining some days in close glasses, I had the pleasure of seeing organic moving particles in all of them. In some they appeared sooner, in others later. Some preserved their motion for months, and others soon ceased to move. Some, at first, produced large moving globules, resembling animals, which changed their figure, split, and became gradually smaller. Others produced only small globules whose motions were extremely rapid; and others produced filaments, which grew longer, seemed to vegetate, and then swelled, and poured out torrents of moving globules. But it is needless to give a detail of my experiments on the infusions of plants, especially since Mr. Needham has published his excellent and numerous observations on this subject. To this able naturalist I have read over the preceding treatise; I have often reasoned with him on the resemblance between the moving bodies in infusions of the seeds of vegetables, and those in the seminal fluids of male and female animals. He thought my views well founded, and of sufficient importance to merit a farther discussion. He, therefore, began to make experiments on the different parts of vegetables; and I acknowledge, that he has brought the ideas I communicated to greater perfection than I could have done. Of this I could give many examples: but I shall confine myself to one, because I formerly pointed out the fact in question, which he describes in the following manner.

To ascertain whether the moving bodies which appear in infusions of flesh were real animals, or only, as I had imagined, organic moving particles, Mr. Needham thought that an examination of the jelly of roasted meat would determine the question; because, if they were animals, the fire would destroy them, and, if not, they would still be perceptible, in the same manner as when the flesh was raw. Having, for this purpose, taken the jellies of veal and of other kinds of roasted meat, he put them in glasses filled with water, and carefully corked the bottles. After some days infusion, he found in the whole of the liquors an immense number of moving bodies. He showed me several of these infusions, and, among others that of the veal jelly, which contained moving bodies very similar to those in the semen of man, the dog, and the bitch, after they had lost their tails or threads. Though they changed their forms, their motions were so similar to those of animals swimming, that, whoever saw them for the first time, or had been ignorant of what has been formerly remarked concerning them, would certainly have conceived them to be real animals. I shall only add, that Mr. Needham has established, by numberless experiments, the existence of moving organic particles in all the parts of vegetables, which confirms what I have alledged, and extends my theory concerning the composition and reproduction of organized beings.

It is apparent, then, that all animals, whether male or female, and every species of vegetable, are composed of living organic particles. These organic particles abound most in the seminal fluids of animals, and in the seeds of vegetables. Reproduction is effected by the union of these organic particles, which are detached from all parts of the animal or vegetable body, and are always similar to the particular species to which they belong; for their union could not be accomplished but by the intervention of an internal mould, which is the efficient cause of the figure of the animal or vegetable, and in which the essence, the unity, and the continuation of the species consists, and will invariably continue till the end of time.

But, before drawing general conclusions from the system I have established, some objections must be removed, which will contribute still farther to illustrate the subject.

It will be demanded of me, why I deny these moving bodies to be animals, after they have uniformly been recognized as such by every man who has examined them? It may likewise be asked, how is it possible to conceive the nature of living organic particles, unless we allow them to be real animals? And to suppose an animal to be composed of lesser animals, is nearly the same idea, as when we say that an organized body is composed of organic living particles. To these questions I shall endeavour to give satisfactory answers.

It is true, that almost all observers agree in regarding the moving bodies in the seminal fluid as real animals. But it is equally certain, both from my experiments, and those of Mr. Needham upon the semen of the calmar, that these moving bodies are beings more simple, and less organized than animals.

The word *animal*, in its common acceptation, represents a general idea, composed of particular ideas which we derive from particular animals. All general ideas include many different ideas, which more or less approach or recede from one another; and, of course, no general idea can be precise or exact. The general idea we have formed of an animal, may be derived from the particular idea of a dog, of a horse, and of other animals, from the power of volition, which enables them to act according to their inclination, and from the circumstances of their being composed of flesh and blood, from their faculty of choosing and of taking nourishment, from their senses, from the distinction of sexes, and from their power of reproducing. The general idea, therefore, expressed by the word *animal*, includes a number of particular ideas, not one of which constitutes the essence of the general idea: for there are animals which have no intelligence, no will, no progressive motion, no flesh or blood, and appear to be only a mass of congealed mucilage: there are others which cannot seek for their food, and only receive it from the element in which they exist; others have no senses, not even that of feeling, at least in a perceptible degree. Some have no sexes, or have both in one individual. There remains nothing, therefore, in the properties of an animal, but the power of reproduction, which is common to both the vegetable and animal. It is from the whole taken together that a general idea must be formed; and, as this whole is composed of different parts, there must of necessity be degrees or intervals between these parts. An insect, in this sense, is less an animal than a dog, an oyster than an insect, and a sea-nettle, or a fresh water polypus, than an oyster: and, as Nature proceeds by insensible degrees, we should find beings partaking of still less animation than a sea-nettle or polypus. Our general ideas are only artificial methods of collecting a number of objects under one point of view; and they have, like other artificial methods, the defect of not being able to comprehend the whole. They are in direct opposition to the procedure of Nature, which is uniform, insensible, and always particular. It is to grasp a number of particular ideas under one word, of which we have no clearer notion than that word conveys; because, when the word is once received, we imagine it to be a line drawn between the different productions of nature; that every thing above this line is an *animal*, and every thing below it a *vegetable*, which is another word equally general, and employed as a line of separation between organized bodies and brute matter. But, as has already been remarked, these lines of separation have no existence in nature. There are bodies which are neither animals, vegetables, nor minerals; and every attempt to arrange them under either of these classes must be ineffectual. For example, Mr. Trembly, when he first examined the fresh water polypus, spent much time before he could determine whether it was an animal or a vegetable. The reason is plain; this polypus is perhaps neither the one nor the other; and all that can be said is, that it has most resemblance to an animal: and, as we are inclined to think, that every organized being is either an animal or a plant, we believe not the existence of any organized body, unless it falls under some of these general denominations, although there must be, and in fact there are, many beings which belong neither to the one nor the other. The moving bodies found in the seminal fluids, and in infusions of the flesh of animals, as well as in those of all parts of vegetables, are of this species: we can neither rank them under animals nor vegetables; and no man in his senses will ever maintain them to be minerals.

We may, therefore, pronounce, without hesitation, that the great division of natural productions into *animals*, *vegetables*, and *minerals*, comprehends not all material beings; since beings exist which can be included in none of these classes. Nature passes, by imperceptible steps, from the animal to the vegetable; but, from the vegetable to the mineral, the passage is sudden, and the interval great. Here the law of imperceptible degrees suffers a violation. This circumstance made me suspect, that, by examining Nature more closely, we should find intermediate organized beings, which, without having the faculty of reproduction, like animals and vegetables, would still enjoy a species of life and motion; beings which, without having the properties either of animals or vegetables, might enter into the constitution of both; and, lastly, beings which would consist of the first assemblages of the organic particles mentioned in the preceding chapters.

Eggs constitute the first class of this species of beings. Those of hens and other female birds are attached to a common pellicle, and derive their nourishment and growth from the body of the animal. But, when attached to the ovarium, they are not properly eggs; they are only yellow globes, which separate from the ovarium as soon as they acquire a certain magnitude: such is their internal organization, however, that they absorb nourishment from the lymph contained in the uterus, and convert it into the white, membranes, and shell. Thus the egg possesses a species of life and organization. It grows and assumes a form by its own peculiar powers: it neither lives like an animal, nor vegetates like a plant, nor enjoys the faculty of reproduction. The egg, therefore, is a distinct being, which can neither be ranked with the animal nor mineral kingdoms. If it be al-

ledged that the egg is only an animal production destined for the nourishment of the chick, and ought to be regarded as a part of the hen; I reply, that eggs, whether impregnated or not, are always organized in the same manner; that impregnation changes only a part which is almost invisible; that it grows, and acquires a uniform figure and structure, both externally and internally, independent of impregnation; and, consequently, it ought to be considered as a separate and distinct being.

This will be still more apparent, if we attend to the growth and formation of the eggs of fishes. When the female deposits them in the water, they are properly but the rudiments of eggs, which, being lately separated from the body of the animal, attract and assimilate those particles that are fitted for their nourishment; and thus increase in size by mere absorption. In the same manner as the egg of the hen acquires its white and membranes while floating in the uterus, the eggs of fishes acquire their white and membranes in the water; and, whether they are fecundated by the male's shedding his milt upon them, or they remain unimpregnated, they still arrive at full perfection. It is plain, therefore, that eggs in general ought to be regarded as organized bodies, and as forming a distinct genus from animals and vegetables.

The organized bodies found in the semen of all animals, and which, like those in the milt of the calmar, are natural machines, and not animals, form a second species of the same genus. They are properly the first assemblages of those organic particles so often mentioned; and, perhaps, they are the constituent particles of all animated bodies. They appear in the semen of every animal, because the semen is only the residue of the organic particles which the animal takes in with its food. The particles, as formerly remarked, assimilated from the food, are those which are most organized, and most analogous to the animal itself: it is of these particles that the semen consists; and, of course, we ought not to be surprized to find organized bodies in that fluid.

To be satisfied that these organized bodies are not real animals, we have only to reflect upon the preceding experiments. The moving bodies in the semen have been considered as real animals, because they have a progressive motion, and something similar to tails. But, after attending, on the one hand, to the nature of this motion, which is suddenly finished, and never again commences, and, on the other, to the nature of the tails, which are only threads adhering to the moving body, we will begin to hesitate; for an animal goes sometimes slow, and sometimes fast; and it sometimes stops, and reposes, without moving at all. These moving bodies, on the contrary, go always in the same direction at the same time; I never saw them stop and again begin to move; and, if they once stop, it is for ever. I demand, if this continued motion, without any repose, is common to animals; and if, from this circumstance, we ought not to doubt concerning the real animation of these moving bodies? an animal should always have a uniform figure, as well as distinct members: but these moving bodies change their figure every moment; they have no distinct members; and their tails are only adventitious matter, and no part of the individual. How, then, can they be esteemed real animals? In seminal liquors, we see filaments which stretch out, and seem to vegetate; then they swell and produce moving bodies. These filaments are, perhaps, of a vegetable nature; but the moving bodies which proceed from them cannot be animals; for we have no example of vegetables giving birth to animals. Moving bodies are found in all animal and vegetable substances promiscuously. They are not the produce of generation. They have no uniformity of species. They cannot, therefore, be either animals or vegetables. As they are to be met with in every part of animals and of vegetable, but are most abundant in their seeds, is it not natural to regard them as the organic living particles of which animals and vegetables are composed, as particles which, being endowed with motion, and a species of life, ought to produce, by their union, moving and living beings, and, in this manner, form animals and vegetables?

But, to remove every doubt upon this subject, let us attend to the observations of others. Can the active machines discovered by Mr. Needham in the milt of the calmar be regarded as animals? Can we believe that eggs, which are active machines of another species, are also animals? If we examine Leeuwenhoek's representations of the moving bodies found in many different substances, shall we not be satisfied, at the first inspection, that they are not animals, since none of them have any members, but are uniformly either round or oval? If we attend to what this famous observer has remarked concerning the motion of these pretended animals, we must be convinced that he was wrong in regarding them as real animals, and we shall be more and more confirmed in the opinion, that they are only organic moving particles. We shall give some examples. Leeuwenhoek gives the figure of the moving bodies in the seminal fluid of a male frog. This figure represents nothing but a thin, long body, pointed at one of the extremities. Let us attend to what he says concerning it: 'Uno 'tempore caput (that is, the largest extremity of the 'moving body) crassius mihi apparebat alio; plerumque 'agnoscebam animalculum haud ulterius quam a 'capite ad medium corpus, ob caudæ tenuitatem, 'et cum idem animalculum paulo vehementius mo-'veretur, (quod tamen tarde fiebat) quasi volumine 'quodam circa caput ferebatur. Corpus fere carebat 'motu, cauda tamen in tres quatuorve flexus volvebatur.'

Here we have the change of figure that I had observed, the mucilage from which the moving bodies with difficulty disengage themselves, the slowness of their motion before they escape from the mucilage, and, lastly, a part of the pretended animal in motion while the other is dead; for, a little afterwards, he observes, 'movebant posteriorem solum partem, quæ ultima morti vicinia esse judicabam.' All this is repugnant to the nature of an animal, but exactly corresponds with my experiments, except that I never saw the tail move, but in consequence of an agitation of the body. Speaking of the seminal fluid of the cod, he says: 'Non est putandum omnia animalcula in semine aselli contenta uno eodemque tempore vivere, sed illa potius tantum, vivere quæ exitui seu partui viciniora sunt, quæ et copiosiori humido innatant præ reliquis vita carentibus, adhuc in crassa materia, quam humor eorum efficit, jacentibus.' If these are animals, why were they not all alive? Why did those only live which were in the most fluid part of the liquor? Leeuwenhoek did not observe, that the thick part, instead of being a humour produced by the animalcules, is a mucilage, which gives birth to them. If he had diluted the mucilage with water, he would at once have given life and motion to the whole. The mucilage itself is often nothing else than a mass of those bodies, which begin to move as soon as they can disengage themselves; and, of course, this thick matter or mucilage, instead of being a humour produced by the animalcules, is only a congeries of the animals themselves, or rather, as formerly remarked, the matter of which they are formed. Speaking of the semen of the cock, Leeuwenhoek, in his letter to Grew, says, 'Contemplando materiam (seminalem) animadverti ibidem tantam abundantiam viventium animalium, ut ea stuperem; forma seu externa figura sua nostrates anguillas fluviatiles referebant, vehementissima agitatione movebantur; quibus tamen substrati videbantur multi et admodum exiles globuli, item multæ plan-ovales figuræ, quibus etiam vita posset attribui, et quidem propter earumdem commotiones; sed existimabam omnes hasce commotiones et agitationes provenire ab animalculis, sicque etiam res se habebat; attamen ego non opinione solum, sed etiam ad veritatem mihi persuadeo has particulas, planam et ovalem figuram habentes, esse quædam animalcula inter se ordine suo disposita et mixta, vitaque adhuc carentia.' Here we have animalcules, in the same seminal fluid, of different forms; and I am convinced, from my own experiments, that, if Leeuwenhoek had observed those oval bodies with attention, he would have perceived that they moved with their own proper force, and consequently that they were as much ailve as the others. This change of figure, it is true, exactly corresponds with what I had observed: but it does not indicate a uniform species of animals; for, in the present example, if the bodies having the figure of a serpent were genuine spermatic animalcules, each of which was destined to become a cock, and therefore implies a uniform and invariable organization, what was the end and destination of those of an oval figure? He, indeed, afterwards remarks, that these oval bodies might be the same with the serpentine, if we suppose them rolled up in a spiral manner. But still, how is it possible to conceive that an animal, with its body in this restrained posture, should be able to move without extending itself? I, therefore, maintain, that these oval bodies were only the organic particles separated from their threads or tails, and that the serpentine bodies were the same particles, which had not yet been deprived of these appendages, as I have often remarked in other seminal fluids.

Besides, Leeuwenhoek, who believed all these moving bodies to be real animals, who established a system upon that foundation, and who affirmed that spermatic animalcules were transformed into men and other animals, now suspected them to be only natural machines, or moving organic particles. He never entertained a doubt, but that these animalcules contained the large animal in miniature. He remarks, 'Progeneratio animalis ex animalculo in seminibus masculinis omni exceptione major est; nam, etiamsi in animalculo ex semine masculo, unde ortum est, figuram animalis conspicere nequeamus, attamen satis superque certi esse possumus figuram animalis ex qua animal ortum est, in animalculo, quod in semine masculo reperitur, conclusam jacere sive esse: et quanquam mihi sæpius, conspectis animalculis in semine masculo animalis, imaginatus fuerim me posse dicere, en ibi caput, en ibi humeros, en ibi femora; attamen cum ne minima quidem certitudine de iis judicium ferre potuerim, hucusque certi quid statuere supersedeo, donec tale animal, cujus semina mascula tam magna erunt, ut in iis figuram creaturæ ex qua provenit agnoscere queam, invenire secunda nobis concedat fortuna.' This opportunity, so much desired by Leeuwenhoek, happily occurred to Mr. Needham. The spermatic animals of the calmar are three or four lines in length, and are visible without the assistance of the microscope. Their whole parts and organization are easily perceived. But they are by no means small calmars, as Leeuwenhoek imagined. They are not even animated, though they have motion, but are only machines, which ought to be regarded as the first union of the organic particles.

Though Leeuwenhoek had not this opportunity of undeceiving himself, he had, however, observed other appearances which ought to have produced this effect. He had remarked, for example, that the spermatic animals of the dog often changed their figure, especially when the fluid was nearly evaporated; that, when dead, they had an opening in the head, which did not appear

when they were alive; and that the head was full and round, during the life of the pretended animal, and flat sunk after its death: these circumstances should have led him to hesitate concerning the real animation of these bodies, and to think that the phænomena corresponded more with a machine which emptied itself, like that of the calmar, than with the properties of an animal.

In the numerous experiments made by Leeuwenhoek, he doubtless observed spermatic animals without tails. He even mentions them in some places, and endeavours to explain the phænomenon. For example, speaking of the semen of the cod, he says: 'Ubi vero ad lactium 'accederem observationem, in iis partibus quas animal-'cula esse censebam, neque vitam neque caudam dig-'noscere potui; cujus rei rationem esse existimabam, 'quod quamdiu animalcula natando loca sua perfecte 'mutare non possunt, tamdiu etiam cauda concinne 'circa corpus maneat ordinata, quodque ideo singula 'animalcula rotundum repræsentent corpusculum.' It would have been more simple, and more agreeable to truth, to have said, that the spermatic animals of this fish sometimes have tails, and sometimes have none, than to suppose that the tails were so exactly wound round their bodies as to give them a spherical figure. One would be apt to think, that Leeuwenhoek had never fixed his eyes upon, or described any moving particles but those which had tails; he has given figures of none that wanted tails, because, though they moved, he did not regard them as animals. This is the reason why all Leeuwenhoek's figures of spermatic animals are very similar. When they appeared in any other form, he thought they were imperfect, or rather that they were dead. Besides, it is apparent from my experiments, that, instead of unfolding their tails, wherever they are placed in circumstances proper for swimming, as Leeuwenhoek insists, these pretended animals gradually lose their tails, in proportion to the rapidity of their motions, till, at last, these tails, which are bodies foreign to the animalcules, or threads which they drag after them, totally disappear.

Leeuwenhoek, speaking of the spermatic animals of man says: 'Aliquando etiam animadverti inter animal-'cula particulas quasdam minores et subrotundas; cum 'vero se ea aliquoties eo modo oculis meis exhibuerint, 'ut mihi imaginarer eas exiguis instructas esse caudis, 'cogitare cœpi annon hæ forte particulæ forent ani-'malcula recens nata; certum enim mihi est ea etiam 'animalcula per generationem provenire, vel ex mole 'minuscula ad adultam procedere quantitatem: et quis 'scit annon ea animalcula, ubi moriuntur, aliorum ani-'malculorum nutritioni atque augmini inserviant!' It appears from this passage, that Leeuwenhoek had seen, in the human semen, animalcules without tails; and that he is obliged to suppose them to be recently produced, which is directly the reverse of what I have observed; for the moving bodies are never larger than when they separate from the filaments, which is the period when their motion begins: but, as soon as they are fully disengaged from the mucilage, they become smaller, and continue to diminish till their motion entirely ceases. With regard to the generation of these animals, which Leeuwenhoek imagines to be certain, no vestige of copulation has been discerned by the most acute observers. It is purely a random assertion, as may be easily proved from his own experiments. He remarks, for example, with great propriety, that the milt of the cod is gradually filled with seminal liquor; and that, after the fish has spent this liquor, the milt dries, and leaves only a flaccid membrane, entirely destitute of every kind of fluid. 'Eo tempore,' says he, 'quo asellos 'major lactes suos emisit, rugæ illæ, seu tortiles lactium 'partes, usque adeo contrahuntur, ut nihil præter pelli-'culas seu membranas esse videantur.' How should this dry membrane, which contains neither seminal liquor nor animalcules, produce animalcules of the same species next season? If they were produced by a regular generation, such a long interruption could not take place, which, in most fishes, continues a whole year. To remove this difficulty, he afterwards remarks: 'Ne-'cessario statuendum erit, ut asellus major semen suum 'emiserit, in lactibus etiamnum multum materiæ semi-'nalis gignendis animalculis aptæ remansisse, ex qua 'materia plura oportet provenire animalcula seminalia 'quam anno proxime elapso emissa fuerant.' This supposition, that part of the seminal liquor remains in the milt for the production of spermatic animals the following year, is perfectly gratuitous, and contrary to observation; for the milt, during this interval, is nothing but a thin dry membrane. But how will he explain a phænomenon that takes place in some fishes, and particularly in the calmar, whose seminal liquors are not only renewed every year, but even the membranes which contain them? Here neither the milt nor the seminal liquor are preserved till the succeeding year; and, of course, their regular reproduction cannot be ascribed to generation. It is therefore apparent, that these pretended spermatic animals are not multiplied, like other animals, by generation; and this circumstance alone would entitle us to conclude, that the moving particles in the seminal fluid are not real animals. Leeuwenhoek, though he tells us, in the passage above quoted, that the spermatic animals are certainly propagated by generation, acknowledges, however, in another place, that the manner in which these spermatic animals are produced is exceedingly obscure, and that he leaves to others the farther elucidation of this subject. 'Per-'suadebam mihi,' says he, speaking of the spermatic animals of the dormouse, 'hæcce animalcula ovibus 'prognasci, quia diversa in orbem jacentia et in semet

'convoluta videbam; sed unde, quæso, primam illorum 'originem derivabimus! an animo nostro concipiemus 'horum animalculorum semen jam procreatum esse 'in ipsa generatione, hocque semen tam diu in testi- 'culis hominum hærere, usquedum ad annum ætatis 'decimum-quartum vel decimum-quintum aut sextum 'pervenerint, eademque animalcula tum demum vita 'donari, vel in justam staturam excrevisse, illoque tem- 'poris articulo generandi maturitatem adesse! sed hæc 'lampada aliis trado.' It is, perhaps, unnecessary to make many remarks on what Leeuwenhoek has here advanced. He saw, in the semen of the dormouse, spermatic animals which were round and without tails; *in semet convoluta*, says he, because he always supposes that they ought to have tails. He was formerly certain that these animals were propagated by generation: here he seems to be convinced of the reverse. But, when he learned, that the vine-fretters (*pucerons*) were propagated without copulation, he laid hold of this idea, in order to explain the generation of spermatic animals. 'Quem- 'admodum,' says he, 'animalcula hæc quæ pediculorum 'antea nomine designavimus (the pucerons) dum adhuc 'in utero materno latent, jam prædita sunt materia se- 'minali ex qua ejusdem generis proditura sunt animal- 'cula, pari ratione cogitare licet animalcula in seminibus 'masculinis ex animalium testiculis non migrare, seu 'ejici, quin post se relinquant minuta animalcula, aut 'saltem materiam seminalem ex qua iterum alia ejusdem 'generis animalcula proventura sunt, idque absque coitu, 'eadem ratione qua supradicta animalcula generari ob- 'servavimus.' This supposition is not more satisfactory than the preceding; for, by thus comparing the generation of spermatic animalcules with that of the vine-fretter we discover not the reason why they are never seen in the human semen till the age of 14 or 15; nor do we learn whence they proceed, or how they are yearly renewed in fishes, &c. Notwithstanding all the efforts of Leeuwenhoek to establish the generation of spermatic animals, he leaves the subject in the greatest obscurity, where it probably would have for ever remained, if we had not discovered, by the preceding experiments, that they are not animals, but organic moving particles, contained originally in the food, and found in vast numbers in the seminal liquors of animals, which are the most pure and most organic extracts derived from the food.

Leeuwenhoek acknowledges, that he did not always find animalcules in the male semen; for example, in that of the cock, which he often examined, he never but once saw the eel-like animalcules: and, some years after, he could not discover these eels, but found animalcules with a large head and a tail, which his drawer could not perceive. He likewise remarks, that, during one season, he could not discover living animals in the seminal fluid of the cod. All these disappointments proceeded from this circumstance, that though he saw moving globules, he was unwilling to acknowledge them to be animals, unless they had tails, though it is in the form of globules that they most generally appear, either in seminal fluids, or in infusions of animal and vegetable substances. In the same place, he remarks, that, though he had often distinctly seen the spermatic animals of the cod, he was never able to make his drawer perceive them.

Before leaving this subject, upon which I have, perhaps, dwelt too long, I must still add another remark, which may lead to some useful conclusions. These pretended spermatic animals, which are nothing but the organic living particles of food, exist, not only in the seminal fluids of both sexes, and in the remnants of food that adhere to the teeth, but likewise in the chyle and in the excrements. Leeuwenhoek, having met with them in the excrements of frogs, and of other animals which he dissected, was at first greatly surprised; and, not being able to conjecture from whence animals could proceed so similar to those in the seminal liquor he had just been examining, he accuses his own want of dexterity, and supposes, that, in dissecting the animal, he had inadvertently opened the seminal vessels, and that the semen had in this manner been mixed with the fæces. But, having afterwards observed the same phænomenon in the fæces of other animals, and even in his own, he was then totally nonplussed. It is worthy of remark, that Leeuwenhoek never found animalcules in his own fæces, but when they were liquid. Whenever his stomach was out of order, and his belly was loose, the animalcules appeared; but, when his food was properly concocted, and his fæces were hard, not a single animalcule was to be found, although he diluted the fæces with water. These facts seem perfectly to coincide with what we formerly advanced; for, when the stomach and intestines properly perform their functions, the fæces are only the gross dregs of the aliment, and all the nourishing and organic particles are absorbed by the lacteal vsssels: in this case we cannot expect to find organic particles in the fæces, which are solely composed of the useless and inert part of our food. But, when the stomach and intestines, from any indisposition, allow the food to pass without being properly digested, then the organic particles mix with the fæces; and, when examined with the microscope, we discover them in the form of living organic bodies. Hence we may conclude, that people who are troubled with looseness, should have less seminal liquor, and be less fitted for the purposes of generation, than those of a contrary habit of body.

I have all along supposed that the female furnishes a fluid equally necessary to generation as that of the male. In the first chapter, I endeavoured to prove, that every organized body contains living organic particles; and,

that nutrition and reproduction are effects of the same cause; that nutrition is performed by absorption, or an intimate penetration of organic particles through all parts of the body; and that reproduction is effected by the superplus of these same organic particles, collected from every part of the body, and deposited in reservoirs destined for that purpose. In Chap. IV. I have shown how this theory applies to the generation of man, and other animals which have different sexes. Females being organized bodies, as well as males, they must also have some reservoirs for the reception of the surplus of organic particles returned from all parts of their bodies. This surplus, as it is extracted from every part of the body, must appear in the form of a fluid; and it is this fluid to which I have given the appellation of the female semen.

This fluid is not inert, as Aristotle pretends, but prolific, and equally essential to generation as the semen of the male. It contains particles distinctive of the female sex, as that of the other sex contains particles proper for the constitution of male organs; and both of them contain all the other organic particles which may be regarded as common to the two sexes: and hence, from a mixture of the two, the son may resemble his mother, and the daughter her father. Hippocrates maintains, that the semen consists of two fluids, one strong, which produces males, and the other weak, which produces females. But, as the seminal fluid is extracted from every part of the body, it is impossible to conceive how the body of a female should produce particles proper for the formation of male organs.

This liquor must enter, by some way or other, into the uterus of viviparous animals; and, in oviparous animals, it must be absorbed by the eggs, which may be regarded as portable matrixes. Each of these matrixes, or eggs, contains a small drop of the female fluid, in that part which is called the cicatrice. This prolific drop, when the female has had no communication with the male, assumes, as Malphigius observes, the form of a mole or inorganic mass; but, when it is penetrated by the semen of the male, it produces a fœtus, which is nourished and brought to perfection by the juices of the egg.

Eggs, therefore, instead of being common to all females, are only instruments employed by nature for supplying the place of uteri in those animals which are deprived of this organ. Instead of being active and essential to the first impregnation, eggs are only passive or accidental parts, destined for the nourishment of the fœtus already formed in a particular part of this matrix, by the mixture of the male and female semen. Instead of existing from the creation, and each including within itself an infinity of males and females, eggs, on the contrary, are bodies composed of a superfluous part of the food, which is more gross, and less organic, than that of which the seminal fluid consists. The egg, in oviparous females, answers the same purposes as the uterus and menstrual flux in the viviparous.

To evince that eggs are destined by nature only to supply the place of an uterus in such animals as are deprived of this organ, we must consider, that females produce eggs independent of the male. The uterus, in viviparous animals, is a part peculiar to the female sex; in the same manner, female fowls, that want this organ, have the defect amply supplied by the successive production of eggs, which necessarily exist in these females, independent of all communication with the male. To pretend that the fœtus pre-existed in the egg, and that eggs are contained, *ad infinitum*, within each other, is equally ridiculous as to maintain that the fœtus pre-existed in the uterus, and that the uterus of the first female contained all the uteri that ever were or will be produced.

Anatomists have applied the term *egg* to things of very opposite natures. Harvey, in his aphorism, *Omnia ex ovo*, by the word *egg*, when applied to oviparous animals, means only the bag which includes the fœtus and all its appendages. He imagined that he perceived the formation of this egg or bag immediately after the junction of the male and female. But this egg proceeded not from the ovarium of the female: he even asserts, that he could not distinguish the smallest alteration in the ovarium. It is apparent, that there is not here the most distant analogy to what is commonly understood by the word *egg*, unless, perhaps, the figure of the bag might have some faint resemblance to that of an egg. Harvey, though he dissected many viviparous females, never could perceive any change in their ovaria; he even regards them as glands totally unconnected with the purposes of generation, though, as we have seen, they undergo very considerable changes. This able anatomist was deceived by the smallness of the glandulous bodies in animals of the deer kind, to which his researches were principally confined.

Harvey was deceived in several other essential articles He insists, that the semen never enters the uterus, and that it is impossible it should find admittance; and yet Verheyen found a great quantity of male semen in the uterus of a cow, which he dissected six hours after copulation. The celebrated Ruysch informs us, that, in dissecting a woman who had been killed immediately after the act of adultery, he found a considerable quantity of male semen, not only in the uterus, but in the Fallopian tubes. Valisnieri likewise assures us, that Fallopius, and other anatomists had discovered male semen in the uteri of several women. This point, therefore, though denied by Harvey, is established by the positive testimony of several able anatomists, and particularly by

Leeuwenhoek, who found male semen in the uteri of many different species of females.

Harvey mentions an abortion, in the second month, as large as a pigeon's egg, without any appearance of a fœtus. In this also he must have been deceived; for Ruysch, and several other anatomists, maintain, that the fœtus is distinguishable by the naked eye, even in the first month of pregnancy. In the History of the French Academy, we have an account of a fœtus completely formed on the twenty-first day after impregnation. If, to these authorities, we add that of Malpighius, who distinguished the chick in the cicatrice immediately after the egg issued from the body of the hen, we cannot hesitate in pronouncing that the fœtus is formed immediately after copulation; and, consequently, no credit is due to what Harvey says concerning the increase of the parts by juxta position; since these parts exist from the beginning, and gradually expand till the fœtus be perfectly mature.

De Graaff differs widely from Harvey in his acceptation of the word *egg*. He maintains, that the female testicles are real ovaria, and contain eggs similar to those of oviparous animals, except that they are much smaller, never fall out of the body, nor detach themselves till after impregnation, when they descend from the ovarium into the uterus. The experiments of De Graaff have contributed more to the belief of the existence of eggs, than those of any other anatomist. They are, notwithstanding totally void of foundation; for this celebrated author, in the first place, mistakes the vesicles of the ovarium for eggs, though they are inseparable from the ovarium, form a part of its substance, and are filled with a species of lymph. 2. He is still more deceived, when he informs us, that the glandulous bodies are only the coverings of these eggs or vesicles; for it is certain, from the observations of Malpighius and of Valisnieri, and from my own experiments, that the glandulous bodies contain no vesicles. 3. He is wrong in maintaining that the glandulous bodies never appear till after impregnation. On the contrary, these bodies are uniformly found in all females, after the age of puberty. 4. He errs in supposing that the globules which he saw in the uterus, and which contained the fœtuses, were the very vesicles that had descended from the ovarium into the uterus, and that, he remarks, had become ten times smaller than when they were in the ovarium. This circumstance alone of their diminished size should have convinced him of his mistake. 5. He is equally unfortunate in maintaining that the glandulous bodies are only the coverings of the fecundated eggs, and that the number of coverings or empty follicles always correspond to the number of fœtuses. This assertion is the reverse of truth; for, on the testicles of all females, we uniformly find a greater number of glandulous bodies, or cicatrices, than of fœtuses actually produced; and they even appear in those which never brought forth. To this we may add, that neither he, Verheyen, nor any other person, ever saw the egg in this pretended covering, or in its follicle, though they have thought proper to rest their system upon that supposition.

Malpighius, who distinguished the growth of the glandulous bodies in the female testicle, was deceived when he imagined that he once or twice discovered the egg in their cavities; for this cavity contains only a fluid; besides, after numberless experiments, no man has ever been able to discover any thing that had the most distant resemblance to an egg.

Valisnieri, who is never deceived with regard to facts, is wrong in maintaining that the egg must exist in the glandulous body, though neither he, nor any man else, was ever able to discover it.

Let us now attend to what may be esteemed the real discoveries of these anatomists. De Graaff was the first who discovered that the testicles of females suffered any change; and he was right in maintaining that they were parts essentially necessary to generation. Malpighius demonstrated, that the glandulous bodies gradually grew to maturity, and that, immediately after, they were obliterated, and left behind them a slight cicatrice only. Valisnieri illustrated this subject still farther. He discovered that these glandulous bodies were found in the testicles of all females; that they were considerably augmented in the season of love; that they increased at the expence of the lymphatic vesicles of the testicle; and that, during the time of their maturity, they were hollow and full of liquor. These are all the truths we have learned concerning the pretended ovaria and eggs of viviparous animals: what conclusions are we to draw from them? two things appear to be evident: the one, that no eggs exist in the testicles of females; the other, that there is a fluid both in the vesicles of the testicle, and in the cavity of the glandulous bodies; and we have demonstrated, in the preceding experiments, that this last fluid is the true female semen, because it contains, like that of the male, spermatic animals, or rather organic particles, in motion.

The seminal fluid of females, therefore, being thus fully ascertained, after what has been said, we must be satisfied that the seminal fluid in general is the superfluous organic part of our food, which is transmitted from all parts of the body to the testicles and seminal vessels of males, and to the testicles and glandulous bodies of females. This liquor, which issues through the nipples of the glandulous bodies, perpetually bedews the Fallopian tubes, and may easily find admission into them, either by absorption, or by the small aperture at their extremity, and in this manner may descend into the uterus. But, on the supposition of the existence

of eggs, which are ten or twenty times larger than the aperture of the tubes, it is impossible to conceive the possibility of their being transmitted to the uterus.

The liquor shed by females in the paroxysm of love, which De Graaff supposes to proceed from lacunæ about the neck of the uterus and the orifice of the urethra, may be a portion of the superfluous fluid that continually distills from the glandulous bodies upon the Fallopian tubes. But perhaps this liquor may be a secretion of a different kind, and no way connected with generation. To decide this question, microscopic observations would be necessary; but *all* experiments are not permitted even to philosophers. I am inclined to think, that, in this liquor, the same spermatic animals, or moving bodies, would be found as appear in the fluid of the glandulous bodies.

Hence we may conclude, that the most libidinous females will be the least fruitful, because they throw out of the body that fluid which ought to remain in the uterus for the formation of the fœtus. We likewise learn why common prostitutes seldom conceive, and why women in warm climates, who have more ardent desires than those of colder regions, are less fertile. But of this we shall afterwards have occasion to treat.

It is natural to imagine that the seminal fluid of either sex should not be fertile, unless when it contains moving bodies. But this point is still undetermined.

The spermatic moving bodies may be regarded as the first assemblages of the organic particles which proceed from all parts of the body; and, when a great number of them unite, they become perceptible by means of the microscope. But, when the number united is small, the body they form is too minute to be visible, and no motion will appear in the seminal fluid, a case which not unfrequently happens. But a long train of successive experiments would be necessary to ascertain the causes of the different states in which this fluid appears.

Of one thing I am certain, from repeated trials, that a seminal liquor, though no motion can be perceived when it is first taken from the body, after being three or four days infused in water, produces as great a number of organic moving particles, as another semen, treated in the same manner, which at first contained vast multitudes. These moving bodies appear likewise in infusions of the blood, of the chyle, of the flesh, and even of the urine, as well as in infusions of all parts of vegetables; and those which appear in all these different substances seem to have nothing peculiar to them. They all move and act nearly in the same manner. If we will have these bodies to be animated, it must be allowed, that they are very imperfect, and ought to be regarded only as the rudiments of animals, or rather as bodies composed of particles essential to the existence of animals. As Nature's productions are uniform, and advance by imperceptible degrees, there is no improbability in supposing the existence of organized bodies which properly belong not either to the animal or vegetable kingdoms.

However this matter may stand, it is fully ascertained, that all animal and vegetable substances contain an infinite number of living organic particles. These particles successively assume different forms, and different degrees of activity, according to different circumstances. They are more abundant in the seminal fluids of both sexes, and in the seeds of plants, than in any other part of the animal or vegetable. There exists, therefore, in vegetables and animals, a living substance which is common to them both; and this substance is the matter necessary to their nutrition. The animal is nourished by vegetable or animal substances; and the vegetable is nourished by the same substances in a decomposed state. This common nutritive substance is always alive and active. It produces an animal or vegetable, whenever it finds an internal mould or matrix accommodated to the one or the other, as has already been explained. But, when this active substance is collected too abundantly in a place where it has an opportunity of uniting, it forms, in the animal body, other living creatures, as the tape-worm, the ascarides, the worms sometimes found in the veins, in the sinuses of the brain, in the liver, &c. Animals of this kind owe not their existence to the generation of individuals of the same species. It is, therefore, natural to think, that they are produced by an extravasation of the organic matter, or by an inability in the lacteal vessels to absorb the quantity of it presented to them. But we shall afterwards have occasion to examine more in detail the nature of these worms, and of other animals which are produced in a similar manner.

When this organic matter, which may be considered as an universal semen, is assembled in great quantities, as in the seminal fluids, and in the mucilaginous part of the infusions of plants, its first effect is to vegetate, or rather to produce vegetating beings. These zoophytes swell, extend, ramify, and then produce globular, oval, and other small bodies of different figures, all of which enjoy a species of animal life; they have a progressive motion, which is sometimes very rapid, and sometimes more slow. The globules themselves decompose, change their figure, and become smaller; and, in proportion as they diminish in size, the rapidity of their motion increases.

I have sometimes imagined, that the venom of the viper, and even the poison of enraged animals, might proceed from this active matter being too much exalted. But I have not yet had leisure for experiments of this kind, nor for ascertaining the nature of different drugs. All I can say at present is, that infusions of the most

active drugs abound with moving bodies, and that they appear sooner in them than in other substances.

Almost all microscopic animals are of the same nature with the moving bodies in the seminal fluids, and in infusions of animal and vegetable substances. The eels in paste, in vinegar, &c. are all of the same nature, and derived from the same origin. But the proofs and illustrations relative to this subject, we shall reserve till we give the particular history of microscopic animals.

CHAPTER IX.

Varieties in the Generation of Animals.

THE nutrition and the reproduction of animals and of vegetables, are thus effected by the same matter. It is a substance universally prolific, and composed of organic particles, the union of which gives rise to all organized bodies. Nature always works on the same stock, and this stock is inexhaustible. But the means she employs to give it value are various; and these general varieties and affinities merit the attention of philosophers, because from them we are enabled to account for particular exceptions to the common plan of her operations.

In general, large animals are less prolific than small ones. The whale, the elephant, the rhinoceros, the horse, man, &c. produce but one, and very rarely two, at a birth. But small animals, as rats, herrings, and insects, produce a great number. Does this difference proceed from the greater quantity of nourishment necessary to support the large animals than the small, and from the former having a less proportional quantity of superfluous nutritive particles, capable of being converted into semen, than the former? It is certain, that the small animals eat more, in proportion to their bulk, than the large. But it is likewise probable, that the prodigious increase of the smaller animals, as bees, flies, and other insects, may be owing to the extreme fineness and delicacy of their organs and members, by which they are enabled to select the most substantial and most organic parts of the animals and vegetables, from which they extract their nourishment. A bee, which lives upon the purest and most refined parts of flowers, receives from its food a greater proportional quantity of organic particles than a horse, who feeds upon hay, straw, and the grosser parts of vegetables. The horse, accordingly, produces but one at a time, while the bee produces many thousands. The oviparous animals are, in general, smaller than the viviparous, and they are likewise much more prolific. The long time that the fœtus remains in the uterus of viviparous animals, is another obstacle to multiplication: during gestation, and the suckling of the young, no new generation can take place. But the oviparous animals, which produce, at the same time, both uterus and fœtus, and throw them out of the body, are almost perpetually in a condition to reproduce; and it is well known, that, if a hen be prevented from sitting, and be fully fed, the number of her eggs may be greatly increased. If hens lay not while they brood, it is because they cease to eat; and for this purpose they leave not their nests but once a day, and even then for a very short time, lest their eggs should be injured by the cold. During this operation, they take not above one tenth part of their ordinary nourishment.

Animals which produce but one at a birth, acquire nearly their full growth before they are fit for generating. But those which produce many, generate before they are half grown. Man, the horse, the ass, the sheep, are incapable of generation till after they have nearly acquired their full growth. It is the same with pigeons and other birds which lay only a small number of eggs: but those which are more prolific, as cocks and hens, fishes, &c. begin to generate much sooner. A cock is capable of this operation at the age of three months, when he is not above one third of his full size. A fish, which, in 20 years, will weigh 30 pounds, generates the first or second year, when it weighs not, perhaps, more than half a pound. But experiments are still wanting to ascertain the growth and duration of fishes: their age may be discovered by examining with a microscope the annual rings or strata of which their scales are composed. But we are ignorant how far this may extend. I have seen, in the Count de Maurepas' ponds, carps which were well attested to be at least 150 years old, and they appeared to be equally active and lively as common carps. I will not say with Leeuwenhoek, that fishes are immortal, or, at least, that they cannot die of old age. Every thing, in time, must perish. Whatever has an origin, a birth, or commencement, must arrive at a termination or death. But fishes, by living in a uniform element, and being sheltered from the injurious vicissitudes of the air, must continue longer in the same state than other animals, especially if these vicissitudes, as Bacon remarks, be the chief causes of the destruction

of animated beings. But the principal cause of the longevity of fishes is, that their bones are softer than those of other animals, and do not perceptibly harden with age. The bones of fishes lengthen, and turn thick without acquiring more solidity. But the density of the bones of other animals continually increases; and, when their interstices are completely filled and obstructed, the circulation of their fluids ceases, and death ensues. But, in the bones of fishes, this augmentation of solidity, which is the natural cause of death, proceeds in such an imperceptible manner, that they must live very long before they can feel any of the effects of old age.

All quadrupeds covered with hair are viviparous, and those covered with scales are oviparous. The close texture of the shells or scales of oviparous animals prevents them from losing so much matter by transpiration as makes its way through the porous skins of the viviparous. May not this retention of superfluous nourishment, which cannot escape by transpiration, be one reason of the extraordinary fertility of these animals, and of their being able to subsist a long time without food? All birds and flying insects are oviparous, except some species of flies which produce their young alive. These have no wings immediately after their birth; but they gradually shoot out as the animal advances in growth; and they are not in a condition to be used till it acquires full maturity. All shell-fishes are oviparous; and likewise those reptiles that have no feet, as snakes and serpents; they change their skins, which are composed of small scales. The viper is but a slight objection to this general rule; for it is not properly viviparous. It first produces eggs, from which the young are hatched: this operation is indeed carried on and completed in the body of the mother; and, instead of laying the eggs, like other oviparous animals, the viper hatches them within the body. The salamander, in which, as Maupertuis remarks, both eggs and young are found at the same time, is a similar exception in oviparous quadrupeds.

Most animals are multiplied and perpetuated by copulation. But many animals, as the greatest number of birds, propagate rather by a kind of compression, than a proper copulation. Some birds, indeed, as the ostrich, the male-duck, &c. have considerable members, and propagate by a real intromission. Male fishes approach the females in the season of spawning. They seem to rub their bellies against each other; for the male often turns on his back to meet the belly of the female. But no actual copulation takes place. The part necessary for this operation does not exist; and the males only approach the females for the purpose of shedding the liquor of their milts upon the eggs, which at that season drop from the females. The male seems to be more attached to the eggs than to the female; for, when she ceases to throw out the eggs, the male instantly abandons her, and follows with ardour the eggs which are carried down by the stream, or dispersed by the wind. He passes and repasses a thousand times over every place where he finds eggs. It is not, surely, for the love of the mother that he makes all these movements: he cannot even be supposed to know her; for he has been often seen shedding his semen promiscuously on all the eggs that came in his way, without having ever met with the female to which they belonged.

Thus some animals are distinguished by sexes, and endowed with members proper for copulation. There are others which likewise have sexes, but want the necessary members. Others, as snails, have both members and both sexes in each individual. Others, as the vine-fretters, have no sexes, are equally fathers and mothers, and produce of themselves without copulation. Though they seem to copulate at pleasure, we are unable to discover the use of the junction, or whether it be really a sexual embrace; unless we should suppose nature to have endowed this small insect with generative faculties superior to those of any other species of animals, and to have bestowed on every individual not only the power of reproduction, but likewise the power of multiplying by sexual communications.

But, whatever varieties take place in the generation of different species of animals, nature prepares the body for it by a new production, which, whether it be external or internal, always precedes generation: immediately before the season of impregnation, the ovaria of oviparous animals, and the testicles of the females of the viviparous, undergo a considerable change. The oviparous animals produce eggs, which gradually increase in size, till they quit the ovarium and fall into the canal of the uterus, where they receive their white, their membranes, and their shell. This production marks the fecundity of the female, and without which generation could not be effected. In viviparous females, in the same manner, one or more glandulous bodies appear upon the testicles, which gradually grow under the membranes that cover them. These glandulous bodies increase, and pierce, or rather elevate the membrane of the testicle; and, when they arrive at maturity, a fissure, or several little holes, appear at their extremities, through which the seminal fluid escapes, and falls into the uterus. These glandulous bodies are new productions, which always precede generation, and without which it could not be effected.

Males undergo a similar change before they are fit for the purposes of generating. In the oviparous animals, the seminal reservoirs are filled, and sometimes the reservoirs themselves ate annually renewed. The milts of some fishes, and particularly of the calmar, are renewed every year. The testicles of birds, immediately before the season of their amours, swell to an enormous degree. The testicles of the males of viviparous animals, especially of those which have seasons, likewise swell

considerably; and, in general, the genitals of every species suffer an erection, which, though it be external and casual, may be regarded as a new production that necessarily precedes the faculty of generating.

Thus in all animals, whether male or female, generation is always preceded by new productions; and, when there is properly no new productions, some of the parts swell and extend to a remarkable degree. In some animals, not only a new production appears, but their whole bodies are renewed, before generation can be effected; as happens in the surprising metamorphosis of insects, which seems to be intended for no other purpose than to enable these animals to propagate their species; for their bodies are full grown before they are transformed. The insect, immediately before its transformation, ceases to take nourishment; and it has no organs proper for generation, no means of converting the nutritive particles, with which it abounds more than any other species of animals, into eggs, or a seminal fluid. Hence the whole of this great surplus of nutritive particles at first unites and moulds itself into a form nearly resembling that of the original animal. The caterpillar becomes a butterfly, because, having no organs of generation, no reservoirs for containing the superfluous nutritive particles, and, consequently, being incapable of producing minute organic bodies similar to the animal itself, the organic nutritive particles, which are always active, assume, by their union, the form of a butterfly, partly resembling that of a caterpillar, both internally and externally, except that the parts of generation are unfolded, and rendered capable of receiving and transmitting the nutritive organic particles which form the eggs and individuals peculiar to the species. The individuals produced by the butterfly ought not to be butterflies, but caterpillars; because it was the caterpillar that received the nourishment, and because the organic particles of this nourishment must therefore be assimilated in the form of a caterpillar, and not of a butterfly, which is only an occasional production of the superfluous nourishment that precedes the real production of animals of this species, and a method employed by nature to accomplish the important purposes of generation, similar to the production of glandulous bodies, and of milts, in other animals.

When the superabundant quantity of organic nutritive particles is not great, as in man, and most large animals, generation does not take place till the growth of the body is nearly completed; and even their prolific powers are limited to a small number of young: but, when these particles are more abundant, as in birds, and oviparous fishes, generation is effected before the animal be fully grown, and the production of individuals is very numerous. When the quantity of organic nutritive particles is still greater, as in insects, it first produces a large organized body retaining the internal and essential constitution of the animal, but differing in several parts as the butterfly differs from the caterpillar; and then it quickly generates an amazing number of young, similar to the animal that first prepared the organic nourishment from which they derived their origin. Lastly, when the quantity of superfluous nourishment is very great, and when the animal, at the same time, possesses the organs necessary to generation, as in the vine-fretters, it first confers on each individual the power of generating, and then a transformation like that which other insects undergo: the vine-fretter becomes a flie; but it can produce nothing, because it is only the residue of the organic particles that had not been employed in the production of the young.

Almost all animals, man excepted, have certain annual seasons appropriated to the purposes of generation. To birds, spring is the season of love: carps, and several other fishes, spawn in June and August. Pikes, and some other fishes, spawn in the spring. Cats have three seasons annually, in the months of January, May, and September. The roe-deer rut in December, wolves and foxes in January, horses in summer, stags in September and October; and almost all insects generate during the autumn only. Some animals, as the insects, are totally exhausted by generation, and die soon after. Others, though they die not, become feeble, are much emaciated, and require a considerable time to repair the great waste of their organic substance. Others are less affected, and are capable of frequently renewing their amours; lastly, man is very little affected, or, rather, he quickly repairs the loss, and therefore is, at all times, in a condition for propagating. All these varieties depend solely on the particular construction of the animal organs. The limits fixed by Nature upon the modes of existing are equally conspicuous in the manner of taking and digesting the food, in the means employed for retaining or throwing it out of the body, and in the instruments by which the organic particles necessary to reproduction are extracted. And, upon the whole, it is apparent, that every thing exists which can exist.

The times of the gestation of females are equally various: some, as mares, carry their young from eleven to twelve months; others, as women, cows, and hinds, carry their young nine months; others, as foxes and wolves, carry five months; bitches carry nine weeks, cats six weeks, and rabbits thirty-one days. Most birds are hatched in twenty-one days; though some of them, as the thistle-finches, hatch in thirteen or fourteen days. Here the variety is equally great as in every other part of the œconomy of animals: the largest animals produce fewer young, and carry them longest, which confirms the doctrine, that the quantity of organic nourishment is proportionally less in large than in small animals; for the fœtus derives its growth and the expansion of its parts from the superfluous nourishment of the

mother; and, as this growth requires longer time in large than in small animals, it is a proof that the quantity of organic particles is not so great in the former as in the latter.

Animals, therefore, are much diversified as to the time and manner of gestation, of engendering, and of producing; and this variety originates from the very causes of generation. For, though the organic matter, which is common to every thing that lives or vegetates, be the general principle of reproduction, the manner of its union, and the combinations it forms, must be infinitely varied, that the whole may become the sources of new productions. My experiments clearly demonstrate, that there are no pre-existing germs, and that the generation of animals and vegetables is not univocal. There are, perhaps, as many beings, which either live or vegetate, produced by a fortuitous assemblage of organic particles, as by a constant and successive generation. It is to such productions that we ought to apply the axiom of the ancients, *Corruptio unius, generatio alterius.* The corruption and resolution of animals and vegetables produce an infinite variety of organized bodies: some of them, as those of the calmar, are only a kind of machines, which though exceedingly simple, are very active. Others, as the spermatic animalcules, seem to imitate the movements of animals. Others resemble vegetables in their manner of growth and expansion. There are others, as those of blighted wheat, which, at pleasure, can be made alternately to live or to die; and it is difficult to know to what they should be compared. There are still others, and in great numbers, which are at first a kind of vegetables, then become a species of animals, and again return alternately to their vegetable state. The more we examine this species of organized bodies, we shall probably discover greater and more singular varieties of them, in proportion as they are farther removed from our observation, and from the structure of other animals with which we are already acquainted.

For example, blighted corn, which is effected by an alteration or resolution of the organic substance of the grain, is composed of multitudes of small organized bodies resembling eels. When infused in water for ten or twelve hours, we discover them to have a distinct wreathing, and a small degree of progressive motion. They cease to move as soon as the water fails them; and their motion commences upon the addition of fresh water. This alternate death and reviviscence may be repeated for months, and even for years; so that these small machines may be made to act as long and as often as we please, without destroying or diminishing their force. They are a species of machines, which begin to act whenever they are immersed in a fluid. These filaments sometimes open like the filaments of the semen, and produce moving globules: we may, therefore, conclude them to be of the same nature, except that they are more fixed and solid.

The eels in paste have no other origin than the union of the organic particles of the most essential parts of the grain. The first eels which appear are certainly not produced by other eels; but, though they are not propagated themselves, they fail not to engender other living eels. By cutting them with the point of a lancet, we discover smaller eels issuing in great numbers out of their bodies. The body of this animal seems to be only a sheath or sac containing a multitude of smaller animals, which perhaps are other sheaths of the same kind, in which the organic matter is assimilated into the form of eels.

A great numoer of experiments would still be necessary to distinguish these animals, which are so singular and so little understoood, into classes and genera. Some of them may be regarded as real zoophytes, which enjoy a kind of vegetation, and which, at the same time, seem to wreath and move like animals. Others appear, at first, to be animals, and then join and form a species of vegetables. A small attention to the resolution of a single grain of corn will elucidate, at least in part, what I have said on this subject. I might add other examples; but those I have given were only produced for the purpose of exhibiting the varieties of generation. There are unquestionably several organized bodies which we consider as real animals, but which are not engendered by others of the same species. Some of them are only a kind of machines; and some of these machines have a certain limited effect, and act for a certain time only, as the machines in the milt of the calmar; others may be made to act as long and as often as we please, as those of blighted grain. There are vegetables which produce animated bodies, as the filaments of the human semen, from which active globules issue and move by their own powers. In the corruption, the fermentation, or rather in the resolution of animal or vegetable substances, we find real animals capable of propagating their species, though they were not themselves produced in this manner. These varieties are, perhaps, more extensive than we imagine. Though it be right to generalize our ideas, to assemble the effects of nature under one point of view, and to class her productions; yet numberless shades, and even degrees, in the great scale of being, will always escape our observation.

CHAPTER X.

Of the Formation of the Fœtus.

FROM the experiments of Verheyen, who found the semen of the bull in the uterus of a cow, and from those of Ruysch, Fallopius, and Leeuwenhoek, who discovered male semen in the uteri of women and many other animals, it seems to be a point fully ascertained, that the semen of the male enters into the uterus of the female. It is probable, that, during the time of coition, the orifice of the uterus opens for the reception of the seminal fluid: but, though this should not happen, the active and prolific part of the semen may penetrate the membranes and substance of the uterus itself; for, as the seminal liquor, as formerly remarked, is almost entirely composed of organic particles, which are very active, and extremely minute, they may pass with the utmost facility through the membranes and substance of the uterus.

What proves that the active part of this fluid may pass through the pores and substance of the uterus, is the sudden change it undergoes immediately after conception. The menses are obstructed, the uterus becomes flaccid, swells, and appears to be inflated. All these changes must be effected by an active external cause, by the penetration of part of the seminal fluid into the substance of the uterus. This penetration is not confined to the surface; it extends through all the vessels and parts of which the uterus is composed, like that penetration by which nutrition, and the expansion of the body, is produced.

We shall the more easily believe this to be the case, when we reflect, that, during the time of gestation, the uterus not only augments in size, but even in its quantity of matter, and that it possesses a species of life, or rather of vegetation, which continues till the child be delivered. If the uterus were only a sac, a reservoir for receiving the semen and retaining the fœtus, it would extend and diminish in thickness, in proportion as the fœtus grew larger. But the augmentation of the uterus is not a simple extension or dilatation of its parts. It not only extends as the fœtus enlarges, but it acquires, at the same time, an additional thickness and solidity; or, in other words, both its size and quantity of matter are greatly increased. This augmentation is a real growth or increase of substance, similar to the expansion of the body in young animals, which could not be effected but by an intimate penetration of organic particles analogous to the substance of those parts. As this expansion of the uterus never happens but after impregnation, the seminal liquor must be the cause by which it is produced; for the uterus is considerably augmented before the fœtus has acquired bulk enough to dilate it by pressing against its internal surface.

It appears, from my own experiments, to be equally certain, that the female has a seminal fluid, which begins to be formed in the testicles, and is brought to maturity in the glandulous bodies. This fluid perpetually distills through the small apertures in the extremities of these bodies, and, like that of the male, enters the uterus by two different ways, either through the apertures at the extremities of the horns of the uterus, or by piercing through the substance of the uterus itself.

These two seminal fluids are extracts from all parts of the body; and a mixture of them is all that is necessary for the formation of a certain number of males and females. The more any animal abounds in this seminal fluid, or the more it abounds in organic particles, the number of young is the greater, as may be remarked in the smaller animals; and the number of young diminishes in proportion as the organic particles are less abundant, as is the case with the larger animals.

But, before taking any farther notice of other animals, we shall examine with attention the formation of the human fœtus. In mankind, as well as in the larger species of animals, the quantity of organic particles in the male and female semen is not great, and, accordingly, they very seldom produce above one fœtus at a time. This fœtus is either a male or a female, according as the number of organic particles predominates in the male or in the female fluid; and the child resembles the father or the mother most, according to the proportional quantities of male or female organic particles in the mixture of the two liquors.

I conceive, therefore, that the seminal fluids, both of the male and of the female, are equally active, and equally necessary for the purposes of propagation: and this, I think, is fully proved by my experiments; for I found in both fluids the same moving bodies; I discovered that the male fluid enters the uterus, where it meets with the fluid of the female; that these two fluids are perfectly analogous; and that they are composed of parts not only similar in their form, but in their action and movements. Now, I imagine, that, by the mixture of the two fluids, the activity of the organic particles

proper to each is stopped; that the action of the one counterbalances the action of the other; that each organic particle, by ceasing to move, remains fixed in the place which corresponds to its nature; and that this place can be no other than that which it formerly occupied in the body of the animal from which it was extracted. Thus all the organic particles which were detached from the head of the animal, will arrange themselves in a similar order in the head of the fœtus. Those which proceeded from the back-bone, will dispose themselves in an order corresponding to the structure and position of the vertebræ. In the same manner, the organic particles which had been detached from any part of the body, will naturally assume the same position, and arrange themselves in the same order that they observed before they were separated from that part. Of course, these particles will necessarily form a small organized body, entirely similar to the animal from which they originally proceeded.

It is worthy of remark, that this mixture of the organic particles of both sexes contains particles which are similar, and particles which are dissimilar. The similar particles are those which have been detached from all the parts that are common to the two sexes. The dissimilar particles are those which have been separated from the parts that distinguish the two sexes. In this mixture, therefore, there is a double portion of particles destined for the formation of the head, the heart, and such parts as are common to both sexes; while there are no more than what are necessary for the production of the sexual parts. Now, the similar particles may act upon each other without producing any disorder; and they may unite in the same manner as if they had proceeded from the same body. But the dissimilar parts cannot act upon each other, nor form any intimate union, because they have no analogy or relation: hence these particles will preserve their original nature without any mixture, and fix their position, without the necessity of being penetrated by others. Thus the particles which proceed from the sexual parts will be first fixed, and those that are common to the two sexes, whether they belong to the male or to the female, will then fix indiscriminately, and form an organized body, which, in its sexual parts, will perfectly resemble the father, if it be a male, and the mother, if it be a female, but which, in the other parts, may resemble either or both.

If what I have advanced be properly understood, we shall, perhaps, be able to obviate an objection to the system of Aristotle, and which might also be urged against the doctrine which I am now establishing. The objection is, Why is not every individual, both male and female, endowed with the faculty of producing an animal of its own sex? I am aware of the difficulty of solving this question, which I have slightly mentioned in the fifth chapter, and shall now proceed farther to illustrate.

From what is delivered in the first four chapters, and from the experiments I have related, it is apparent, that reproduction is effected by the assemblage and union of the organic particles, detached from every part of the animal or vegetable body, in one or several common reservoirs; that these particles are the same which serve for the nutrition and expansion of the body; and that both effects are produced by the same matter, and by the same laws. I think I have established this point by so many facts and reasonings, that it is impossible to entertain a doubt concerning its truth. But I allow, that the question may be put, Why every separate animal and vegetable produces not its own likeness, since every individual detaches from all its parts, and collects, in a common reservoir, the organic particles necessary for the formation of a small organized body? why is not this organized body formed? and why, in most animals, is a mixture of the fluids of both sexes necessary? If I were to reply, that, in all the vegetable tribes, in all those animals that multiply by cuttings, and in the vine-fretters, which produce without any sexual commerce, the general intention of Nature seems to be, that each individual should multiply its own species, and that reproduction by the intervention of sexes is only an exception to this general law. It might, with propriety, be rejoined, that the exception is perhaps more universal than the rule itself. To maintain that all individuals would have the faculty of reproducing, if they were endowed with proper organs, and if they contained the matter necessary for nourishing the embryo, is not removing the difficulty: for, in females, all these circumstances concur; and yet the influence of the male is indispensable to the production either of a female or of a male fœtus.

But, we come nearer a solution of the question, when we maintain, that, though the fluid in the testicles and seminal vessels of the male contain all the organic particles necessary for the formation of a male fœtus, yet these particles cannot receive any local establishment or arrangement of parts, because a constant circulation of them goes on by means of absorption, and by the perpetual succession of new supplies from all parts of the body; and that, as the same circulation of the organic particles takes place in the female, neither of them can possibly multiply without the assistance of the other; because, in the mixture of the male and female fluids, the different organic particles of which they consist have a greater affinity to each other than they have to the body of the female where the mixture happens. But, though this explication were admitted, why, it may still be asked, does not the ordinary mode of generation correspond with it? for, upon this supposition, each individual would produce, and, like snails, mutually impregnate one another, every individual receiving the organic particles furnished by the other, which, without being

injured by any foreign power, would unite solely by the affinity between the particles themselves. If there were no other cause by which the organic particles could be united, perhaps this mode of generation would be the most simple. But it is contrary to the analogy of Nature. Few animals are endowed, like snails, with both sexes; and, therefore, if this mode of propagating were the most simple, it would be more generally employed by Nature. This solution, of course, amounts to no more than a gratuitous supposition, that males produce not, solely because they have not organs proper for containing and nourishing a fœtus.

It may be still farther supposed, that the activity of the organic particles in the semen of each individual requires to be counterbalanced by the force or action of those of the other individual, in order to reduce them to a fixed state, or equilibrium, without which the formation of the fœtus cannot be effected; and that the motion of the organic particles of the female cannot be counterbalanced by any other cause than a contrary action in the organic particles received from the male. But this answer is too general to be void of obscurity. However, when we attend to all the phænomena, it may, perhaps, admit of some illustration. The mixture of the two seminal fluids produces not only a male or female fœtus, but other organized bodies, which are endowed with the faculty of growth or expansion. The placenta, the membranes, &c. are produced at the same time, if not sooner, than the fœtus. There are, therefore, in the seminal fluid of the male or female, or in the mixture of both, organic particles not only suited to the production of the fœtus, but of the placenta and membranes. Since there are no parts either in the male or female bodies from which they could be detached, whence do these particles proceed? It must be admitted, that the organic seminal particles of each sex being equally active, uniformly produce organized bodies every time that they can fix themselves, by their mutual action upon one another; that, of the particles destined to produce a male, those peculiar to the male sex will fix first, and form the sexual parts; that the particles common to both sexes may afterwards fix themselves indifferently, in order to form the rest of the body; and that the placenta and membranes are produced by the excess of organic particles which have not been employed in the formation of the fœtus. If, as we have supposed, the fœtus be a male, all the organic particles peculiar to the female sex, which have not been employed, as also the superfluous particles of both individuals which have not entered into the composition of the fœtus, and which cannot be less than one half of the whole, remain for the formation of the membranes and placenta. If the fœtus be a female, the same quantity of superfluous organic particles still remain, and are occupied in forming the placenta and membranes.

But it may be said, that the membranes and placenta, upon this supposition, ought to become another fœtus, which would be a male, if the first was a female; and a female, if the first was a male; because the first fœtus consumed only the organic particles peculiar to the sex of one individual, and the half of those particles which were common to both sexes; and, of course, the sexual particles of the other individual, and the other half of the common particles, remain still unexhausted. To this I reply, that the first union of the organic particles prevents a second, at least under the same form; and that the fœtus, being first formed, exerts an external force, which destroys the natural arrangement of the other organic particles, and throws them into that order which is necessary for the formation of the placenta and membranes.

From the experiments and observations formerly made, it is apparent, that all animated beings contain an amazing quantity of living organic particles. These living particles we have found in every animal and vegetable substance; and we are certain, that all these particles are equally necessary to the nutrition, and, consequently, to the reproduction of animals and vegetables. That the union of a certain number of these particles, therefore, should produce an animated being, it is not difficult to conceive. As each particle is animated, a whole, or any assemblage of them, must be endowed with life. These living organic particles being common to all animated beings, they are capable of forming particular species of animals or of vegetables, according to the peculiar arrangement they assume. Now, this arrangement depends entirely on the form of the individuals which furnish the organic particles. If they are furnished by an animal, they arrange themselves under the form peculiar to its species, exactly agreeable to that arrangement they observed when they nourished or expanded the animal itself. But, does not this regular arrangement suppose the necessity of some base or centre, round which the particles assemble in order to unite and form a fœtus? This basis is furnished by the particles which form the sexual parts. I shall illustrate this point.

As long as the organic particles of either sex remain alone, their activity produces no effect, because it is not opposed by any resistance or reaction from particles of a different kind. But, when the male and female liquors are blended, the particles detached from the sexual parts, being of a different kind, serve as a base to fix the activity of the other particles.

Upon this supposition, that the organic particles which, in the mixture of the two fluids, represent the sexual parts of the male, can alone serve as a basis to the particles which proceed from all parts of the female; and that those proceeding from all parts of the male can only be fixed by the particles which are detached from

the sexual parts of the female; we may conclude, that the sexual parts of the male fœtus are formed by the organic particles of the father, and the rest of its body by the organic particles of the female; and, on the contrary, that the female fœtus derives nothing but its sex from the mother, and the rest of its body from the father. Boys, therefore, except in the parts which distinguish their sex, ought to resemble the mother more than the father, and girls should resemble the father more than the mother.

Considering generation by sexes under this light, we should conclude it to be the most common manner of reproduction, as it is in reality. Beings of the most perfect organization, as animals, whose bodies make a whole that is incapable of division, and whose powers are all concentrated into one point, cannot be reproduced in any other way; because they contain only particles that are perfectly similar, and cannot be united but by means of different particles furnished by another individual. But vegetables, which are less perfect in their organization, and which can be divided without destruction, are capable of being reproduced in different ways: 1. Because they contain dissimilar particles; 2. Because the form of these bodies is less fixed and determined than that of an animal, different parts may supply the functions of each other, and vary according to circumstances: the roots of a tree, when exposed to the air, push out branches and leaves; and thus the organic particles of vegetables obtain a local establishment, become fixed, and produce individuals in many different ways.

The same phænomenon is exibited in animals whose organization is less perfect, as in the fresh water polypus, and others, which are capable of reproducing by the division of their parts. These organized bodies, instead of single animals, may be considered as bundles of organized beings united by a common membrane, as trees are composed of an infinite number of minute trees. The vine-fretters, which propagate individually, likewise contain dissimilar particles; because, after producing their young, they change into barren flies. Snails mutually communicate dissimilar particles to each other; and, therefore, each individual is fruitful. Thus, in every mode of generation with which we are acquainted, we find, that the necessary union of the organic particles cannot be effected but by the admixture of different particles, to serve as a common basis, and to fix or destroy their activity.

According to this general idea of sexes, we may suppose, that the distinction of sex extends through all nature; for sex, in this sense, is nothing but that part of bodies which furnishes organic particles of a different kind from those of the common parts, and which serve as a basis for their union. But it is, perhaps, useless to reason on a question which can be solved at once, by saying, that, as God has created sexes, animals must necessarily be produced by their intervention. We are not in a condition, as I formerly remarked, to explain why things exist; we are unable to explain why nature almost universally employs sexes for the reproduction of animals, or why sexes exist. We ought, therefore, to content ourselves with reasoning concerning things as they are. If we attempt to rise higher, we lose ourselves in the regions of fancy, and forget the narrow limits of our capacity.

Leaving, therefore, all farther subtleties, I shall adhere to nothing that is not founded on facts and observation. I find that the reproduction of bodies is effected in many different modes: but, at the same time, I clearly perceive, that animals and vegetables are reproduced by the union of the organic particles detached from all parts of their bodies. I am certain that these active organic particles exist in the seeds of vegetables, and in the seminal fluids of animals, both male and female; and have no doubt that every species of reproduction is accomplished by the union and admixture of these particles. It is equally unquestionable, that, in the generation of man, and other animals, the organic particles of the male and female mix at the time of conception; because we often see children who resemble both father and mother: and, what confirms this theory is, that all the particles common to the two sexes mix together promiscuously, but that the particles peculiar to the sexes never mix; for we daily perceive children with eyes resembling those of their father, while their mouth and front resemble those of the mother. But we never see any such mixture of resemblances in the sexual parts; we never find in the same individual, the testicles of the father, and the vagina of the mother.

The formation of the fœtus, therefore, is effected by the mixture of the organic particles of both sexes; and this mixture fixes or gives a local establishment to the particles, because it is made according to the laws of affinity which take place between the different parts, and which determine the particles to arrange themselves in the same order they observed when they existed in the individuals who furnished them. The particles which proceed from the head, for example, cannot, according to these laws, take up their station in the legs, or in any other part but the head of the fœtus. All the particles are in motion when they first unite; and this motion must be round the point or centre of union.

This basis or central point, which is necessary to the union of the particles, and which, by its reaction and inertia, fixes and destroys their activity, is probably the first assemblage of particles that proceed from the sexual parts, because they are the only particles in the mixture which differ from those common to both sexes.

I imagine, therefore, that, in the mixture of the two fluids, the organic particles which come from the sexual

parts of the male fix themselves first, and cannot unite with those which proceed from the sexual parts of the female, because they are of a different nature, and have less affinity to each other than the particles that come from the eye, the arm, or any other part of the female. Round this centre, or point of union, the other organic particles successively arrange themselves in the same order they formerly existed in the body from which they were derived; and, according as the particles of the one or of the other individual most abound, or are nearer this central point, they enter in greater or less quantities into the composition of the new being, which, in this manner, is formed in the middle of a homogeneous fluid; at the same time, vessels begin to shoot, which increase in proportion to the growth of the fœtus, and furnish it with proper nourishment. These vessels, which have a peculiar species of organization, are probably formed by the excess of the organic particles that have not been admitted into the composition of the fœtus; for, as these particles are both active, and furnished with a base or point of union from the organic particles peculiar to the sexual parts of the other individual, they must arrange themselves in the form of an organized body, but not in the form of another fœtus; because their position with respect to each other has been changed by the different movements of the particles which entered into the composition of the first fœtus. From the union of these superabundant particles, therefore, an irregular body must arise, which will resemble the fœtus in nothing but its growth and expansion, because, though this body be composed of the same organic active particles with the fœtus, their position and form must be different, as they were thrown aside from the centre or point of union, which served as a basis for the formation of the fœtus.

When the quantity of seminal fluid of both individuals is great, or, rather, when these liquors abound with organic particles, different centres of attraction are formed in different parts of the mixture; and, in that case, by a mechanism similar to what has been mentioned above, several fœtuses are formed, some of them males, and others females, according as the particles of the one sex or of the other are most active. But, from the same centre of attraction, two fœtuses can never originate; because two centres are requisite for this purpose. Besides, if this arrangement were to happen, no particles would be left for the formation of the placenta and membranes; because they would all be employed in constituting the second fœtus, which would necessarily be a female, if the other was a male. All that could happen in a case of this kind would be, that some of the particles common to both individuals, being equally attracted by the first centre of union, must arrive there at the same time, and produce a monster, or a fœtus with superfluous parts; or, if some of the common particles should fix at too great a distance from the first centre, or be constrained by the attraction of the second, round which the placenta is formed, a monster, defective in some part, would be the consequence.

That the organic particles peculiar to the sexual parts serve for a basis or centre of union to the other particles of which the embryo is formed, I pretend not to demonstrate: but, as they are the only particles which differ from the rest, it is more natural to imagine that they should answer this purpose than those which are common to both individuals.

I formerly detected the errors of those who maintained, that the heart, or the blood, were first formed. The whole is formed at the same time. We learn from actual observation, that the chicken exists in the egg before incubation. The head, the back-bone, and even the appendages which form the placenta, are all distinguishable. I have opened a great number of eggs, both before and after incubation, and I am convinced, from the evidence of my own eyes, that the whole chicken exists, in the middle of the cicatrice, the moment the egg issues from the body of the hen. The heat communicated to it by incubation, expands the parts only, by putting the fluids in motion. But we have never been able to determine, with certainty, what parts of the fœtus are first fixed, at the moment of its formation.

I have always maintained, that the organic particles were fixed, and that they united in consequence of their motion being suspended. Of the truth of this fact I am fully convinced; for, if the male and female semen be separately examined, we find in both a great number of moving particles; but, when these fluids are mixed, the motion of the particles is totally destroyed, and a certain degree of heat is necessary to renew their activity; for the chicken, which exists in the centre of the cicatrice, has no motion before incubation; and, even 24 hours, or two days afterwards, when we begin to perceive it without the microscope, it has not the smallest appearance of motion. During the first two or three days, the fœtus is only a small white mucilaginous mass, which gradually acquires consistence and magnitude. But this progress is exceedingly slow, and has no resemblance to the rapid movements of the organic particles in the seminal fluid. Besides, I maintained, not without reason, that the motion of the organic particles was entirely destroyed; for, if eggs be kept without exposing them to the degree of heat that is necessary for the expansion of the chicken, the embryo, though completely formed, will remain without any motion, and the organic particles of which it is composed will continue fixed, without being able to give life and motion to the embryo which was formed by their union. Thus, after the motion of the organic particles is stopped, and after they have united in such a manner as to form a fœtus, some external cause is still necessary to give them life and motion.

This cause, or agent, is heat, which, by rarifying the fluids, obliges them to circulate: this circulation makes all the organs act; and nothing farther is necessary for the growth and expansion of the parts than the continuation of this heat.

Before the action of this external heat, there is not the smallest appearance of blood; and I never could perceive any change of colour in the vessels till about 24 hours after incubation. In the vessels of the placenta, which communicate with the body of the fœtus, the blood first appears. But it would seem that this blood loses its red colour, as it approaches the body of the animal; for the chicken is entirely white; and, during the first, second, and third days, after incubation, we can with difficulty perceive a few red particles near the animal's body, but which seem not to make any part of it, though these red particles are destined for the formation of the heart. Thus the formation of blood is an effect produced by the motion communicated to the fluids by heat; and even this blood is formed without the body of the animal, the whole substance of which consists of a white mucilage.

The fœtus, as well as the placenta, receive the nourishment that is necessary for their expansion by a species of absorption; and they assimilate the organic particles of the liquor in which they swim: for, it is an equal impropriety to say that the placenta nourishes the animal, as that the animal nourishes the placenta. If the placenta nourishes the fœtus, the former would diminish in proportion to the growth of the latter, which by no means happens; for both augment together. I have, indeed observed, that, in eggs, the placenta at first grows much more in proportion than the fœtus, and, consequently, it may nourish the animal; or, rather, it conveys nourishment to the chick by means of absorption.

What we have said concerning the chicken, admits of an easy application to the human fœtus, which is formed by the union of the organic particles of the two sexes. The membranes and placenta are produced by the superabundant particles that enter not into the composition of the fœtus, which is now inclosed in a double membrane, containing also a quantity of fluid. This fluid is at first, perhaps, nothing but a portion of the seminal liquors of the father and mother; and, as the fœtus is not thrown out of the uterus, it enjoys, from the moment of its formation, as much external heat as is sufficient for its expansion. This heat communicates motion to the fluids; it gives play to all the organs; and the blood is formed in the placenta, and in the body of the fœtus, solely by the motion excited by the heat. We might even maintain, that the formation of the blood in a child is as independent of the mother, as that which arises in the egg is independent of the hen that covers it, or of the furnace which heats it.

It is certain that the fœtus, the membranes, and the placenta, are all nourished and expanded by absorption; for, at first, the sac that contains the whole product of generation does not adhere to the uterus: and we have seen, from the experiments of De Graaff upon female rabbits, that he made the globules which contained the fœtuses roll about in the uterus. They could receive no nourishment, therefore, but by absorbing the fluids that constantly bedew the uterus, to which they afterwards begin to adhere by means of a mucilage that gradually gives origin to small blood vessels, as shall afterwards be more fully explained.

But, to return to the formation of the fœtus, concerning which we have to make several remarks, both as to its situation, and to the different circumstances that may prevent or alter the mode of its production.

In the human species, the semen of the male enters into the uterus, the cavity of which is considerable; and, when it meets with a sufficient quantity of female semen, the two instantly mix, and the organic particles unite and form the fœtus. The whole is, perhaps, performed in a moment, especially if the two fluids be in an active state. The cavity of the uterus is the proper place for the formation of the fœtus; because the semen of the male has an easier admission into the uterus than into the Fallopian tubes or ovarium; and, as the uterus has only a small aperture, which is always shut, except when opened by the ardour of love, the materials of generation remain there in safety, unless they be disturbed by some rare and accidental circumstance. But, as the male fluid moistens the vagina, before it penetrates the uterus, and, as the organic particles are exceedingly active, it may penetrate as far as the Fallopian tubes and ovarium. In the same manner, as the female fluid is already perfected in the glandulous bodies of the testicles, from which it distills and moistens the Fallopian tubes, before it descends into the uterus; and, as it may escape through the lacunæ round the neck of the uterus, it is not impossible that the mixture of the two liquors may take place in all these different places. Fœtuses, therefore, may frequently be formed in the vagina, and instantly fall out of it, having nothing proper for their retention. They may also be sometimes formed in the Fallopian tubes; but instances of this kind must be rare.

Anatomists mention, that fœtuses have been found, not only in the Fallopian tubes, but likewise in the ovaria. M. Theroude a surgeon in Paris, showed to the academy a rude mass which he found in the right ovarium of a girl of 18 years of age. Two open fissures, garnished with hair like the eye-lids, were perceived in this mass. Above these eye-lids was a kind of front, with a black line in the place of eye-brows. Immediately above the front, there were several hairs collected into two separate pencils, one of them about seven inches long, and the other three. Below the

angle of the eye, two large, hard, white dentes molares appeared, together with their gums: these teeth were about three lines long, and about a line distant from each other. Several other teeth appeared, situated at different distances. In the same volume M. Mery is reported to have found in the ovarium of a woman an upper jaw-bone, with several teeth in it, so perfect that they appeared to be at least of ten years growth. In the Medical Journal, published by the Abbé de la Roque, we have the history of a woman, who died of her ninth child, which had been formed *in* or *near* one of the ovaria; for, from the description, it is not clear whether the child was within the ovarium, or adjacent to it only. This fœtus was about an inch thick, and completely formed. In the Philosophical Transactions, examples are recorded of teeth, hair, and bones being found in the ovaria of women. If all these facts can be credited, the seminal liquor of the male must be supposed sometimes, though rarely, to mount up to the ovaria. But there are many considerations which render this point extremely doubtful: 1. The facts which seem to support it are few: 2. The only instance of a perfect fœtus found in the ovarium, is narrated in a very suspicious manner by M. Littre. Neither is it impossible that the seminal fluid of the female alone may sometimes produce organized masses, as moles, cists full of hair, of bones, or of flesh. Besides, if we are to believe anatomists, fœtuses may be formed in the testicles of men as well as in those of women; for we are told by a surgeon in the second volume of the History of the Old Academy, that he found a fœtus, with its membranes, in which the head, the feet, the eyes, the bones and cartilages, were distinguishable, in the scrotum of a man. Were all these facts equally worthy of credit, we must necessarily adopt one of the two following hypotheses; either that the seminal fluid of each sex can produce nothing without being mixed with the other; or, that either of the fluids alone is capable of producing irregularly organized masses. If we maintain the former hypothesis, to explain the facts above related, we shall be obliged to admit, that the male fluid sometimes ascends to the ovarium, and, by mixing there with the female fluid, forms organized bodies; and also, that the female fluid, by being copiously effused in the vagina, may, in the time of coition, penetrate as far as the scrotum of the male, in the same manner as the venereal virus often reaches that part; and, consequently, that an organized body may be formed in the scrotum by a mixture of the male and female fluids. If the other hypothesis, which is the most probable, be adopted, namely, that the seminal fluid of each individual may separately produce organized masses, then all these osseous, fleshy, and hairy bodies, which sometimes appear in the ovaria of females, and in the scrotum of males, may derive their origin from the seminal fluid of the individual in which they are found. But it is needless to speculate farther concerning facts which seem to be more uncertain than inexplicable; for I am inclined to think, that the seminal fluid of each individual may singly produce something; and young girls, for example, may produce moles, without any intercourse with the male, in the same manner as hens lay eggs without the intervention of the cock. I might support this opinion with observations equally credible as those we have just now quoted. M. de la Saone, a physician and anatomist, published a treatise on this subject, in which he assures us, that nuns, though strictly cloistered, sometimes produce moles: and why should this be impossible, since hens produce eggs without any communication with the cock, and since we find, in the cicatrices of these eggs, instead of a chicken, a mole with its appendages? The analogy here is sufficiently strong to make us at least suspend a rash determination. Whatever be in this, it is certain, that a mixture of the two fluids is necessary for the formation of a fœtus, and that this mixture cannot be properly effected but in the uterus, or in the Fallopian tubes, where anatomists have sometimes discovered fœtuses: and it is natural to imagine, that those which have been found in the cavity of the abdomen, have escaped by the extremity of the tube, or by some accidental rupture of the uterus; and that they never fall into the abdomen from the ovarium, because I think it next to impossible that the seminal fluid should ascend so far. Leeuwenhoek has computed the motion of his pretended spermatic animals to be four or five inches in 40 minutes; so that, if the whole fluid moved at this rate, in an hour or two the animalcules might proceed from the vagina into the uterus, from the uterus into the Fallopian tubes, and from the Fallopian tubes into the ovaria. But, how is it possible to conceive, that the organic particles, whose motion ceases whenever they are deprived of the fluid part of the semen, should arrive at the ovarium, unless they were accompanied with the liquor in which they swim? The moving particles cannot give a progressive motion to the fluid which contains them. Thus, whatever activity may be ascribed to these organic particles, we cannot conceive how they should arrive at the ovarium, and there form a fœtus, unless, by some unknown power, the fluid should be absorbed by the ovarium, a supposition which is not only gratuitous, but contrary to probability.

The difficulty attending this supposition confirms the opinion, that the male fluid enters the uterus, either by its orifice, or by penetrating its substance. The female fluid may likewise find its way into the uterus, either by the aperture at the extremity of the Fallopian tubes, or by penetrating the substance of the tubes and uterus. M. Weitbrech, an able anatomist of the Academy of Petersburg, has clearly proved that the seminal fluid can penetrate through the substance of the uterus; and yet

there are no vessels through which it could pass. We must, therefore, conclude, that it penetrates through the spongy substance of the parts, and that it not only enters the uterus, but may even issue out of it when the parts are irritated.

But, though this penetration should be regarded as impossible, it cannot be denied, that the female fluid, which distills from the glandulous bodies of the ovaria, may fall into the uterus, by entering the apertures at the extremities of the Fallopian tubes, as the male fluid enters by the orifice of the uterus itself; and, consequently, that the fœtus may be formed in the cavity of the uterus, by the mixture of the two fluids, in the manner already explained.

CHAPTER XI.

Of the Expansion, Growth, and Delivery of the Fœtus, &c.

In the expansion of the fœtus, two different species of growth are distinguishable: the first, which immediately succeeds the formation of the fœtus, is not uniform in all the parts of the animal. The nearer the fœtus approaches to maturity, the growth of the parts is more proportional; and it is not till after the birth, that all the parts grow nearly in an equable manner. We must not imagine, that the fœtus, at the time of its formation, has the exact figure of an adult. The small embryo, it is true, contains all the parts essential to a man; but they differ in their successive expansion.

In an organized body, like that of an animal, some parts may be supposed to be more essential than others; and though none of them are useless or superfluous, yet there are some to which others seem to owe their growth and disposition. Some parts may be considered as fundamental, without which the animal could not exist, and others as only superficial and accessory. The latter seem to derive their origin from the former, and to be intended more for conferring symmetry and external ornament on the animal, than for enabling it to exist, or to perform the functions essential to life. These two different species of parts are successively expanded, and are almost equally apparent at the time of birth. But there are other parts, as the teeth, which arrive not at full maturity till several years after; and others, as the glandulous bodies in the female testicles, the beard of males, &c. which appear not till the age of puberty.

To discover the fundamental and essential parts of an animal body, attention must be had to the number, situation, and nature of the whole. Those which are simple, those whose position is invariable, and those without which the animal cannot exist, must necessarily be the most essential. Those, on the contrary, which are double, or more numerous, those which vary in size and position, and those which may be taken away without injuring or killing the creature, may be regarded as less essential, or more accessory to the animal machine. Aristotle mentions, that the only parts essential to all animals are those with which they take and digest their nourishment, and throw out the superfluous part of it from the body. The whole intestinal canal is indeed extremely simple, and no other part can supply its place. The head and back-bone are likewise simple parts, the position of which is invariable. The back-bone is the foundation of the animal frame; and the action and movement of most members of the body depend upon the spinal marrow which that bone contains. It is this part also, together with the head, which appears first in the embryo. Now, these simple parts, which are first formed, are all essential to the existence and the form of the animal.

The double parts in an animal body are more numerous than the single parts; and they seem to be produced on each side of the single parts by a species of vegetation; for the double parts are similar in form and different only in position. The left hand is perfectly similar to the right; but, if the left hand were placed in the situation of the right, we could not perform the same actions with it. The same thing may be observed of all the double parts: they are similar in form, but differ in position, which is relative to the body of the particular animal; and, if a line were drawn, dividing the body into two equal parts, the position of all the similar parts would tend to this line as to a centre.

The spinal marrow, and the vertebræ in which it is inclosed, appear to be the real axis of all the double parts of the animal body, from which they seem to derive their origin, and to be only proportional branches issuing from this trunk or common base; for, in the young chick, we see the ribs shooting from each side of the vertebræ, as the small branches shoot out from the principal branch of a tree. In all embryos, the middle of the head and the vertebræ first appear; we then see, on each side of the vesicle which composes the middle of the head, two other vesicles which seem

to proceed from the first; these two vesicles contain the eyes, and the other double parts of the head. In the same manner, we perceive an equal number of small tubercles issuing from each side of the vertebræ, which gradually extend, and form the ribs, and other double parts of the trunk. Lastly, the arms and legs appear like small tubercles on each side of the trunk. This first growth is very different from what afterwards takes place: it is the production of parts which appear for the first time; the growth which succeeds is only an expansion of parts already formed.

The order and symmetry of the double parts in all animals, their regular position, the equality of their extension and growth, and the perfect similarity of their structure, seem to indicate, that they derive their origin from the single parts; that a certain force resides in the single parts which acts equally on each side; or, which amounts to the same, they are the bases or fulcra against which the action of those powers that produce the expansion of the double parts is exerted; and that the action of these forces, both on the right and left sides, are precisely equal, and counterbalance each other.

Hence we may conclude, that, if there is any defect, or redundance, in the matter destined for the formation of the double parts, as the forces are equal on each side, this defect or excess must take place both in the right and left sides. If, for example, from a defect of matter, a man has but two fingers in the right hand, in place of five, the same defect will appear in the left; if, from an excess of matter, there be six fingers in the right hand, he will have the same number in the left; or, if the matter be vitiated, and produces a change in the parts of one side, the same change will appear in the other. Of this fact we have daily proofs: the parts of monsters are always deranged in a certain order and proportion.

This harmony in the position of the double parts of animals, is likewise apparent in vegetables. The branches push out small ramifications on each side; the small nerves in the leaves are equally disposed with regard to the principal nerve; and, if the symmetry appears to be less exact in vegetables than in animals, this proceeds only from its being more various, and because its limits are more extensive, and less precise. But the same order is easily recognisable; and the single and essential parts are perfectly distinct from those which are double; and it is evident that the latter derive their origin from the former.

It is impossible to determine the form of these double parts before their expansion, or in what manner they are complicated, or what figure results from their position in relation to the single parts. The body of an animal, at the instant of its formation, unquestionably contains all the parts of which it ought to be composed: but the relative disposition of these parts is then very different from what afterwards appears. If we examine the expansion of a young leaf of a tree, we will find that it is plaited on each side of the principal nerve; and that its figure, at this time, has no resemblance to that which it afterwards assumes. When we amuse ourselves with plaiting paper, in order to give it the form of a crown, of a boat, &c. the different plaits of the paper seem to have no resemblance to the figure which results from their expansion: we only perceive that the plaits are uniformly made in a certain order and proportion, and that, whatever is done on one side, is also done on the other. But, to determine the figures which may result from the expansion of any given number of folds, is a problem beyond the powers of geometry. The science of mathematics reaches not what immediately depends upon position. Leibnitz's art of *Analysis situs* does not yet exist; though the art of knowing the relations that result from the position of things would be, perhaps, more useful than that which has magnitude only for its object; for we have more occasion to be acquainted with form than with matter.

In the expansion of natural productions, the folded or plaited parts not only assume different positions, but they acquire, at the same time, extension and solidity. Since, therefore, we are unable to ascertain the exact result of a simple expansion of a folded figure, in which, as in folded paper, nothing takes place but a change of position among the parts, without any augmentation or diminution of the quantity of matter, how is it possible for us to judge concerning the expansion of the compound body of an animal, in which not only the relative position, but likewise the quantity of matter in these parts, suffer considerable changes? We can only reason, therefore, on this subject, by drawing conclusions from the examination of objects at different periods of their expansion.

We, indeed, perceive the chick in the egg before incubation: it swims in a transparent fluid, contained in a small purse formed by a very fine membrane in the centre of the cicatrice. But the chick is then only a particle of inanimated matter, in which no organization or determined figure can be distinguished. We can perceive, however, that one of its extremities is the head, and the other the back-bone. The embryo, in this state, seems to be the first product of fecundation, resulting from the mixture of the male and female semen. To ascertain this fact, several things require attention: when the hen has, for some days, been along with the cock, and afterwards separated from him, the eggs produced 20 days or a month after this separation, are equally fertile as those laid during her cohabitation with the male. The eggs produced at the end of this period require only the usual time of 21 days in hatching; and their embryos are equally advanced both in form and consistence. From this circumstance we might be led to imagine, that the form in which the embryo appears before incubation, is not the immediate effect of the

mixture of the two seminal fluids, but that it existed in different forms during the abode of the egg in the body of the mother; for the embryo, in the form in which we see it before incubation, requires only the aid of heat in order to bring it to maturity. Now, if this form of the embryo had existed 21 days or a month before, when the egg was first impregnated, why was it not hatched by the internal heat of the mother? Why do we not find the chick completely formed in those eggs which have been impregnated 21 days before they are laid?

But this difficulty, though seemingly great, is not insurmountable. When the hen cohabits with the cock, the cicatrice of each egg, which contains the semen of the female, receives a small quantity of the male fluid. The eggs in the ovarium of oviparous females are analogous to the glandulous bodies in the testicles of the viviparous: the cicatrice of the egg corresponds to the cavity of those glandulous bodies which contain the female semen; and that of the male penetrates and mixes with it. The formation of the embryo instantly results from this mixture or union of the two fluids. The first egg laid by the hen after her communication with the cock is fecundated, and capable of being hatched. Those which she is afterwards to lay were all impregnated at the same instant: but, as they want some essential parts, the production of which has no dependence on the male fluid: as they have neither the white, the membranes, nor the shell, the small embryos contained in the cicatrices of these imperfect eggs, are incapable of being hatched, though aided by the internal heat of the mother. The embryo, therefore, remains in the cicatrice in the same state in which it was first formed, till the egg acquires all the parts necessary to the growth and nourishment of the fœtus; and it is not till after the egg has arrived at full perfection, that the expansion of the embryo commences. This expansion is effected by the external heat of incubation: but it is unquestionable, that, if the egg could be retained in the body twenty-one days after it was completely formed, the chick would be hatched, unless the internal heat of the mother were too great; for the degrees of heat necessary for hatching eggs are very limited; and the least excess or defect is equally fatal to this operation. The last eggs, therefore, laid by the hen, containing the embryos in the same state as the first, prove nothing more than the necessity of their acquiring full perfection before they can be hatched.

It is apparent, therefore, that the state of the embryo when the egg is laid by the hen, is its first state, and that which immediately succeeds impregnation; that it undergoes no intermediate changes of form; and, consequently, by tracing, as Malpighius has done, its gradual expansion, hour after hour, we discover every thing that it is possible for us to know, unless we could perceive the mixture of the two fluids, and the manner in which the particles arrange themselves during the first formation of the embryo.

If we reflect on this instantaneous fecundation of a number of eggs, which are to be laid at successive intervals, we shall discover a new argument against the existence of eggs in viviparous animals: for, if women contained eggs, like hens, why are not many of them fecundated at the same time? Why does not one impregnation give birth to a successive race of children? And, when women conceive two or three children, why do they always come into the world at the same time? If these fœtuses were produced from eggs, would they not succeed each other according to tne different states of perfection of the several eggs existing at the time of impregnation? And would not superfœtations be as frequent as they are rare, and as natural as they are accidental?

It is impossible to trace the gradual expansion of the human fœtus, as we can that of the chick in the egg. The opportunities for observation are few; and all we know of this subject is derived from the writings of anatomists, surgeons, and accoucheurs. It is from collecting all their particular observations, and comparing their remarks with their descriptions, that the following abridged history of the human fœtus has been compiled.

Immediately after the mixture of the two seminal fluids, it is probable that the whole materials of generation exist in the uterus, under the form of a small globe; for we learn from anatomists, that, three or four days after conception, there is a small globular mass in the uterus, the greatest diameter of which is about six lines, and the least four. This globe is formed by a delicate membrane, which contains a limpid liquor very like the white of an egg. We may already perceive, in this liquor, some small fibres, which are the first rudiments of the fœtus. Upon the surface of the globe there is a net-work of delicate fibres, which extends from one of the extremities to the middle: these are the first vestiges of the placenta.

Seven days after conception, the lineaments of the fœtus are distinguishable by the naked eye. They are, however, very imperfect, and have the appearance of a jelly almost transparent, though it has acquired some degree of solidity. The head and trunk may be easily distinguished; because this mass is of an oblong figure, and the trunk is longest and most delicate. Some small fibres, resembling a plume of feathers, issue from the middle of the fœtus, and terminate in the membrane in which it is inclosed. These fibres are the rudiments of the umbilical cord.

Fifteen days after conception, the head and the most prominent features of the face are apparent. The nose resembles a small elevated thread perpendicular to a line which marks the division of the lips: two small black points represent the eyes; and we see two holes

in place of ears. The body of the fœtus has also acquired some growth. On each side of the superior and inferior parts of the trunk, those small protuberances appear, which are the rudiments of the arms and legs. The length of the whole body is about five French lines.

Eight days after, in all three weeks, the body of the fœtus is augmented only about a line: but the arms and legs are apparent. The growth of the arms is quicker than that of the legs; and the fingers separate sooner than the toes. The internal organization now begins to be visible: the bones appear like fine threads. The ribs are disposed on each side of the back-bone like minute threads: the arms, the legs, the fingers and toes, are also represented by similar threads.

At one month, the fœtus is more than an inch in length: it naturally assumes a curved posture in the middle of the liquor that surrounds it; and the membranes in which the whole is included, are both augmented and thickened. The whole mass is of an oval figure, the greatest diameter of which is about an inch and a half, and the least about an inch and a quarter. The human figure is no longer equivocal: all the parts of the face are already distinguishable; the body is delineated; the haunches and the belly are prominent; the hands and legs are formed, and their fingers and toes are divided; the skin is thin and transparent; the viscera resemble a knot or plexus of fibres; the vessels are like fine threads, and the membranes are extremely delicate: the bones are still soft, and it is in a few places only that they have begun to assume some degree of solidity. The vessels which form the umbilical cord lie parallel to each other in a straight line. The placenta now occupies only a third of the whole mass, instead of a half, which it did during the first days; the superficial growth of the placenta, therefore, has not been so great as that of the fœtus and mass; but it has received a great augmentation in solidity; it has become proportionally thicker than the membranes of the fœtus, both of which are now distinguishable.

According to Hippocrates, the male fœtus expands sooner than the female.

At the end of six weeks, the fœtus is about two inches long, and the human form begins to be more perfect, only the head is very large in proportion to the other parts of the body. About this time the motion of the heart becomes visible: in fifty days, the heart has been perceived to beat for a considerable time after the fœtus was extracted from the uterus.

In two months, the fœtus is more than two inches in length; and the ossification is perceptible in the middle of the two arm-bones, in the thigh and leg, and in the point of the under jaw, which is then greatly advanced before the upper. These, however, are only osseus points. But, by means of a quicker growth, the clavicles are entirely ossified: the umbilical cord is formed, and the vessels which compose it begin to twist like the threads of a rope: but this cord is very short in comparison of the length it afterwards acquires.

In three months the fœtus is nearly three inches long, and weighs about three ounces. Hippocrates asserts, that at this time the motions of the male fœtus begin to be felt by the mother; but that those of the female are not perceptible till four months. Some women, however, affirm that they have felt the motions of the fœtus at the beginning of the second month. It is difficult to acquire any certain knowledge on this subject: the sensations excited by the first movements of the fœtus depend more, perhaps, on the sensiblity of the mother, than the strength of the child.

Four months and a half after conception, the length of the fœtus is from six to seven inches. All the parts are greatly augmented, and easily distinguishable from each other: even the nails appear on the fingers and toes. The testicles of the male are shut up in the belly above the kidneys. The stomach is filled with a thick fluid, similar to that which is contained in the amnios. In the small guts we find a milky fluid, and a black liquid matter in the great guts. There is a small quantity of bile in the vesica fellis, and a little urine in the bladder. As the fœtus floats freely in the fluid that surrounds it, there is always some space between its body and the membranes in which it is contained. These membranes, at first, grow more rapidly than the fœtus; but after a certain time, the reverse takes place. Before the end of the third month, the head is bent forward; the chin rests on the breast; the knees are elevated, and the legs folded back upon the thighs. One of the hands, and often both, touch the face. Afterwards, when the fœtus acquires more strength, it perpetually changes its position, as we learn from the following observations made by persons skilled in the art of midwifery: 1. The umbilical cord is often twisted round the body and members of the child, in a manner that necessarily supposes different motions and positions. 2. Mothers feel the motion of the child sometimes on one side of the uterus, and sometimes on the other; and it often strikes against many different places, which could not happen unless it assumed different positions. 3. As the fœtus swims in a fluid which surrounds it on all sides, it may easily turn, extend, and twist itself by its own powers: it must likewise take different situations, according to the various attitudes of the mother's body; when the mother, for example, lies down, the position of the fœtus must differ from what it is when she stands.

Most anatomists maintain, that the fœtus is obliged to bend its body, because it is too much confined by the membranes. But this opinion seems not to be well founded; for, during the first five or six months, at

least, there is room more than sufficient to admit a full extension of the fœtus; and yet, during all this period, the fœtus is bended. We see likewise that the chick is bended in the liquor of the amnios, while, at the same time, this membrane, and the fluid it contains, afford room sufficient to hold a body five or six times larger than the fœtus. We may therefore conclude, that the bended posture of the fœtus is natural, and not the effect of restraint. I am inclined to think, with Harvey, that the fœtus takes this posture, because it is most favourable to rest and sleep; for all animals bend their bodies when they want to repose themselves, or to sleep: and, as the fœtus sleeps almost continually, it naturally assumes this advantageous position.

The uterus, as formerly remarked, grows very quickly after pregnancy; and it continues to increase proportionally with the fœtus. But the growth of the fœtus at last exceeds that of the uterus; and it is natural to think, that the fœtus, when near maturity, is too much confined, and agitates the uterus by repeated motions. The mother feels these successive efforts, which are called periodic pains, after the labour of child-bearing commences. The more force the fœtus exerts in order to dilate the uterus, it finds an increased resistance from the natural elasticity of the parts. Hence every effort tends to open the os tincæ, or orifice of the uterus, which has already been gradually enlarged during the last months of pregnancy. The head of the fœtus pushes along against the margins of this orifice, and dilates it by a constant pressure, till the moment of delivery, when it opens so wide as to allow a free passage to the child.

What renders it probable that the labour-pains are occasioned by the dilatation of the os tincæ is, that this dilatation is the only certain mode of distinguishing the real from the false pains. Women often feel very brisk pains, which are not those that immediately precede delivery. To distinguish those false from the true pains, Deventer advises the accoucheur to feel the orifice of the uterus, and maintains, that, if the pains be true, the dilatation will augment upon the accession of every pain; and that, on the contrary, if the pains be false, the orifice will rather contract than dilate, or, at least, that it will not continue to dilate. Hence we may conclude, that these pains proceed not from a forced dilatation of the orifice of the uterus. The only thing that is embarrassing, is the alternation of pain and of ease experienced by the mother. This circumstance does not perfectly correspond with the cause we have assigned; for the gradual and continued dilatation of an orifice should produce a constant pain, without any intervals of ease. Perhaps the alternations may be ascribed to the separation of the placenta: it adheres to the uterus by the insertions of a number of small papillæ. May we not, therefore, suppose that these papillæ separate not from their cavities all at once; and that the successive separation of these papillæ gives rise, at different intervals, to the fresh accessions of pains? here the effect perfectly corresponds with the cause; and this conjecture may be supported by another remark: immediately before delivery, there issues out a viscous whitish liquor, similar to that which flows from the papillæ of the placenta, when torn from the uterus. It is therefore extremely probable, that this liquor, which issues from the uterus, is produced by the separation of some of the papillæ of the placenta.

It sometimes happens, that the fœtus escapes from the uterus without bursting the membranes, and, consequently, without discharging the liquor they contain. This species of birth seems to be the most natural, and is similar to that of most animals. The human fœtus, however, commonly pierces the membranes, by the resistance it meets with at the orifice of the uterus: and sometimes a part of the amnios, and even of the chorion, is brought away adhering to the head of the child like a cap. As soon as the membranes are pierced or torn, the liquor, which is called the *waters*, runs out, and, by lubricating the vagina and orifice of the uterus, facilitates the passage of the child. After the discharge of the waters, there is sufficient room left in the uterus for the midwife to return the child, when its position is unfavourable to the birth. After the child comes into the world, the delivery is not completed. The placenta and membranes still remain in the uterus; and the child is attached to them by means of the umbilical cord: they are easily brought away by the hand of the midwife; and sometimes the weight of the child is sufficient. These organs, which were necessary to the existence of the fœtus, become useless, and even noxious to the child, after birth. They are, therefore, instantly disengaged from the child's body, by casting a knot on the umbilical cord, about an inch from the navel, and by cutting the cord an inch above the ligature. In six or seven days, the remains of the cord dry up, and fall off close to the navel.

By examining the fœtus before birth, we are enabled to form some ideas concerning the mechanism of its natural functions. There are organs necessary to it while in the womb of the mother, but which become useless immediately after birth. The better to comprehend these functions, we must explain more fully the nature of these accessory parts, the umbilical cord, the membranes, with the liquor they contain, and the placenta. The umbilical cord, which is attached to the body of the fœtus at the navel, is composed of two arteries and a vein: by these the course of the circulation is lengthened; but the vein is larger than the arteries. At the extremity of the cord, each of these vessels divide into an infinite number of ramifications, and extend themselves between two membranes. They set off from the common trunk in such a manner, that the whole ramifications

assume a round form, and are distinguished by the name of placenta, because they resemble a cake. The central part of the placenta is thicker than its edges: its mean thickness is about an inch, and its diameter is eight or nine inches, and sometimes more. Its external surface, which is applied to the uterus, is convex, and the internal surface is concave. The blood of the fœtus circulates in the cord and in the placenta. The arteries of the cord proceed from two large arteries in the fœtus, and carry the blood through all the arterial ramifications of the placenta; and the blood is collected and returned to the fœtus by the venous branches of the placenta and the umbilical vein.

The concave surface of the placenta is covered with the chorion: its convex surface is also covered with a soft membrane, which seems to be a continuation of the chorion, and is easily torn; and the fœtus is inclosed in the double covering of the chorion and amnios. The figure of the whole is globular, because the intervals between the fœtus and membranes are filled with a transparent fluid. This liquor is immediately confined by the amnios, which is the internal membrane: it is thin and transparent, and folds itself round the umbilical cord, at its insertion into the placenta, and continues to cover it the whole way to the navel of the fœtus. The chorion is the external membrane; it is thick, spongy, and interspersed with blood-vessels. It consists of several coats, the outermost of which covers the convex surface of the placenta. It sends off duplicatures to cover the papillæ, which are inserted into the cavities at the fundus of the uterus, called *lacunæ*. These insertions connect the fœtus to the uterus.

Some anatomists have maintained, that the human fœtus, like those of certain quadrupeds, was furnished with an *allantois*, a membrane destined for the reception of the urine; and they have pretended to have discovered it between the chorion and amnios, or in the middle of the placenta, at the root of the umbilical cord, under the form of a pretty large bladder; and that it received the urine by means of a long tube, which made a part of the cord, and which opened at one end into the bladder, and, at the other, into the allantois, answering the same purposes as the urachus in other animals. They acknowledge, however, that the urachus of the human fœtus is not near so large as in quadrupeds; but they assert that it is divided into a number of small tubes, and that the urine passes into their cavities.

To these facts are opposed the experience and observation of most anatomists. They seldom find any vestiges of an allantois either between the chorion and amnios, or in the placenta; nor do they perceive any urachus in the umbilical cord. A kind of ligament, indeed, runs from the external surface of the bottom of the bladder to the navel; but, when entering the cord, it becomes so delicate as to be almost reduced to nothing. Neither is this ligament commonly hollow; and we can perceive no corresponding aperture in the bottom of the bladder.

The fœtus has no communication with the open air; and the experiments made upon the lungs demonstrate that they have never respired; for they sink in water, while those of infants, who have breathed, uniformly swim: the fœtus, therefore, has no respiration in the womb of the mother; consequently, it can make no sound with its voice; and all the stories of children groaning and crying before birth must be regarded as fabulous. After the waters run off, however, the air may find admission into the cavity of the uterus, and the child may begin to respire before its birth. In this case, the child may cry, in the same manner as the chicken cries before the shell of the egg is broken, which it is enabled to do by means of the air lodged in a cavity between the external membrane and the shell: this air exists in all eggs, and is produced by the fermentation of the matters they contain.

The lungs of the fœtus, having no motion, receive no more blood than is sufficient for their nourishment and growth: another passage, therefore, is open for its circulation. The blood in the right auricle of the heart, instead of passing into the pulmonary artery, and, after circulating through the lungs, returning into the left auricle by the pulmonary vein, passes directly from the right to the left auricle, through an aperture called the *foramen ovale*, which is in the partition of the heart that separates the two auricles: the blood then enters the aorta, by the ramifications of which it is distributed to every part of the body; it is then taken up by the numerous branches of the veins, which gradually unite into one trunk, called the *vena cava*, that terminates in the right auricle of the heart. The blood contained in this auricle does not all pass through the foramen ovale; part of it escapes into the pulmonary artery, but it enters not into the body of the lungs; for there is a communication between the pulmonary artery and the aorta, by an arterial canal which leads immediately from the one to the other. It is by these means that the blood circulates in the fœtus, without entering the lungs, which it does in children, in adults, and in all animals who respire.

It has been imagined by some, that the blood of the mother passes into the body of the fœtus, by means of the placenta and umbilical cord: they supposed, that the blood-vessels of the uterus opened into the lacunæ, and those of the placenta into the papillæ, and that they inosculated with one another. But this opinion is contradicted by experiment. When the arteries of the umbilical cord are injected, the liquor returns by the veins, without any of it escaping externally. Besides, the papillæ can be drawn out of the lacunæ in which they are lodged, without any extravasation of blood either from

the uterus or placenta; from both there oozes out a milky matter, which, we have already remarked, serves for the nourishment of the fœtus. It is probable that this liquor enters the veins of the placenta in the same manner as the chyle enters the subclavian vein; and the placenta, perhaps, performs the office of the lungs in maturating the blood. One thing is certain, that the blood appears much sooner in the placenta than in the fœtus; and I have often observed, in eggs which had been sat upon for a day or two, that the blood appeared first in the membranes, and that their blood-vessels are numerous and large, while the whole body of the fœtus, except the point where these blood-vessels terminate, is only a white transparent matter, in which there is not the least vestige of blood.

It has been imagined that the liquor of the amnios is a nourishment received by the mouth of the fœtus. Some have even pretended to have found this liquor in the stomach, and to have seen several fœtuses who wanted the umbilical cord entirely, and others who had only a small portion of it, which had no connexion with the placenta. But, in this case, may not the liquor have passed into the body of the fœtus by the portion of the cord that remained, or even by the navel itself? Besides, other facts may be opposed to these: fœtuses have been found, whose lips were not separated; and others whose œsophagus had no aperture. To reconcile these facts, some anatomists have maintained, that the aliment passed into the fœtus partly by the umbilical cord, and partly by the mouth. But none of these opinions seem to have any foundation. The question is not, how the fœtus alone, but how the whole apparatus of generation, receive their growth and nourishment? For the placenta, the liquor, and the membranes, increase in bulk as well as the fœtus; and, consequently, those instruments and canals employed for receiving and transporting nourishment to the fœtus, are themselves endowed with a species of life. The expansion of the placenta and membranes is equally difficult to conceive as that of the fœtus; and, it may be said, with equal propriety, that the fœtus nourishes the placenta, as that the placenta nourishes the fœtus. At the commencement of growth, the whole mass floats in the uterus, without any adhesion; and, of course, the nourishment can only be conveyed by an absorption of the lacteous fluid contained in the uterus. The placenta appears first to attract this fluid, which it converts into blood, and transports by the veins into the fœtus. The *liquor amnii* seems to be nothing but this milky fluid in a purified state, the quantity of which is augmented, by a similar absorption, in proportion to the growth of the membranes; and the fœtus probably absorbs this liquor, which seems to be necessary for its growth and nourishment: for, it is worthy of remark, that the fœtus, during the first two or three months, contains very little blood: it is as white as ivory, and appears like a congeries of lymph somewhat consolidated; and, as the skin is transparent, and all the parts extremely soft, the body of the fœtus may be easily penetrated by the fluid in which it swims, and thus receive the matter necessary for its growth and expansion. It may indeed be supposed that the fœtus afterwards receives nourishment by the mouth; because we find a liquor, similar to that of the amnios, in the stomach, urine in the bladder, and meconium, or excrement, in the intestines; and, as neither urine nor meconium appear in the amnios, it is natural to conclude, that no excrements are voided by the fœtus, especially as some are born without having the anus perforated, and yet large quantities of meconium are found in their intestines.

Though the fœtus has no immediate connection with the uterus, but is only attached to it by the small external papillæ of the placenta; though it has no communication with the blood of the mother, but, in some measure, is equally independent of her as the egg is independent of the hen which covers it; yet it has been maintained, that, whatever affects the mother, produces a similar effect upon the fœtus, and that the impressions received by the former are communicated to the sensorium of the latter. To this imaginary influence have been attributed all those resemblances, monstrosities, and peculiar marks which appear on the skin of particular children. Many of these marks I have examined, and they uniformly appeared to be occasioned by a derangement in the texture of the skin only. Every mark must necessarily have a faint resemblance to something or other: but such resemblances, I am persuaded, depend more on the imagination of those who see them, than upon that of the mother. On this subject, the marvellous has been pushed to an extreme degree. The fœtus has not only been said to bear the real representations of the appetites of the mother, but that, by a singular sympathy, the marks which represent strawberries, cherries, &c. assumed a deeper colour during the season of these fruits. A little attention, however, will convince us, that these changes of colour are more frequent, and that they happen whenever the motion of the blood is accelerated, whether it be occasioned by the heat of summer, or by any other cause. The marks are always either yellow, or red, or black; because the blood gives these colours to the skin when it enters in too great quantities into the vessels. If these marks were occasioned by the appetites of the mother, why are not their forms and colours as various as the objects of her desires? What a multitude of strange figures would be exhibited, if all the whimsical longings of a mother were written upon the skin of the child?

As our sensations have no resemblance to the objects which excite them, it is impossible that desire, fear,

horror, or any other passion or emotion, can produce real representations of the objects by which they are occasioned. An infant being, in this respect, equally independent of the mother as the egg is independent of the hen that sits upon it, I should be equally induced to believe that the imagination of a hen, which saw by accident a cock's neck twisted, should produce wry-necked chickens from the eggs she was hatching, as that a woman that saw a man broke upon the wheel, should produce, by the mere force of imagination, a child with all its limbs broken.

But, supposing this fact to be well attested, I still maintain that the imagination of the mother could not be the cause of it: for, what is the effect of horror? An internal movement, or if you please, a convulsion of the mother's body, which might alternately compress and stretch the uterus. What would be the result of this commotion? Nothing similar to its cause; for, if the commotion was very violent, the fœtus might be killed, wounded, or have some of its parts deranged: but how is it possible to imagine that this commotion should produce in the fœtus any thing similar to the thoughts of the mother, unless we suppose, with Harvey, that the uterus possesses the faculty of conceiving ideas, and of realising them upon the fœtus?

But, if the imagination of the mother has no effect upon the fœtus, it may still be demanded, Why did this child come into the world with its members broken? Though a direct solution of a fact, which is both extraordinary and uncertain, is not to be expected; yet, I think, this question admits of a satisfactory answer. Phænomena of the most uncommon kind, and which are but rarely exhibited, as necessarily happen as those that are usual and frequent. Among the infinite combinations of which matter is capable of forming, arrangements of the most peculiar and extraordinary species must sometimes take place. Hence, out of the numberless children which daily come into the world, one may sometimes appear with two heads, with four legs, or with all its members broken. It is, therefore, within the circle of nature, that a child, without the aid of the mother's imagination, may be born with its arms and legs broken. This phænomenon may have been exhibited oftener than once; the mother of this child may, during her pregnaney, have seen a man broken on the wheel; and the defects of conformation in the child may have been attributed to the impulse made, by this dreadful spectacle, upon the imagination of the woman. But independent of this general solution, the fact may be explained in a more direct manner. The fœtus, as formerly remarked, has nothing in common with the mother. Its functions, its organs, its blood, its movements, are all peculiar, and belong to itself alone. The only matter it derives from the mother, is the liquor or nutritive lymph which distills from the uterus. If this lymph suffers any change, if it be infected with the venereal virus, the infant is affected with the same disease; and it is reasonable to think that all the diseases which proceed from vitiated humours may be communicated from the mother to the child. We know that the small pox is communicated in this manner; and we have too many examples of children, immediately after birth, becoming innocent victims of the debauchery of their parents. The venereal virus attacks the most solid parts of the bones; and it appears to act with more force upon the middle of the bones, which is the part where the ossification first commences. and is, of course, the most hard and solid part. I conceive, therefore, that the infant in question has been affected with the venereal disorder while in the womb of its mother, and that this was the reason why it came into the world with its bones broken through the middle.

The same effect might be produced by the rickets: in the royal cabinet, there is a skeleton of a rickety child, the bones of whose legs and arms are joined in the middle by a callus: from inspecting this skeleton, it appears that its bones had been broken before birth, and afterwards reunited by a callus.

But we have dwelt too long upon a fact which credulity alone has rendered marvellous. Prejudice, especially that species of it which is founded in wonder, will always triumph over reason. It is needless to attempt to persuade women that the marks on their children have no connection with their ungratified longings. I have sometimes asked them, before the birth of a child, of what particular longings they had been disappointed, and, of course, what marks the child would bear? but I had only the satisfaction of perplexing, without convincing them.

The time of gestation is generally about nine months, but it is sometimes longer and sometimes shorter. Many children are born in the seventh and eighth, and some not till after the ninth month: but, in general, the births before the ninth month are more frequent than those which exceed that term.

It is generally believed, that children born in the eighth month cannot live, or, at least, that more of them die than of those who come into the world in the seventh month. This opinion appears to be paradoxical; and, if we consult experience, I believe it will be found to be erroneous. A child born in the eighth month is more perfectly formed, and consequently more vigorous and lively, than one who is born in the seventh. This opinion, however, is very commonly received, and is founded on the authority of Aristotle: 'Cæteris animantibus ferendi uteri unum est tempus, homini vero plura sunt; quippe et septimo mense et decimo nascitur, atque etiam inter septimum et decimum positis; qui enim mense octavo nascuntur, *etsi minus*,

'tamen vivere possunt.' The beginning of the seventh month is the earliest term of delivery. If the fœtus be rejected sooner, it dies, and is denominated an abortion. Thus the time of gestation is more various in the human species than in other animals; for it extends from the 7th to the 10th, and, perhaps, to the eleventh month.

We are assured by women who have had many children, that females remain longer in the womb than males. If this be true, it is not surprising that female children should sometimes be born in the 10th month. When infants come into the world before the 9th month, they are neither so large nor so well formed as those who appear not till a later period. Those, on the contrary, who remain in the womb till the 10th month, are larger and better made; their hair is longer, the growth of the teeth, though still concealed within the gums, is more advanced; and the tone of their voice is deeper and more distinct.

With regard to the occasional causes of delivery, there is much uncertainty. It is imagined by some writers, that, when the fœtus has acquired a certain size, the capacity of the uterus becomes too small for its retention, and that the restraint felt by the child obliges it to exert every effort to break its prison. Others alledge, which amounts nearly to the same thing, that the fœtus becomes too heavy to be supported by the uterus, which, therefore, opens to be discharged of its load. Neither of these reasons appear to be satisfactory: the uterus has always sufficient capacity and strength to contain and support the weight of a child of nine months; for it is often loaded with two, during the same period; and it is certain, that the weight and size of two children of eight months, for example, exceed those of a single infant of the same age. Besides, it is not unfrequent that a child of nine months is less than another at eight months, though it still remains in the womb.

Galen pretends that the fœtus continues in the uterus till it is able to take nourishment by the mouth, and that the want of proper food makes it restless and anxious to escape. It has been said by others, that the fœtus is originally nourished by the mouth, but that, in process of time, the liquor amnii is so contaminated with the urine and transpiration of the fœtus, that it becomes perfectly disgustful, and obliges the child to use every method to effect its escape from the womb.

These reasons seem not to be more satisfactory than the former; for from them it would follow, that the smallest and weakest fœtuses would necessarily remain longer in the womb than those of larger and more robust bodies; which is by no means the case. Besides, it is not for nourishment that the child, immediately after birth, seems to be anxious; for it can want food for a considerable time after: it appears, on the contrary, to be extremely desirous of easing itself of the superfluous load of nourishment (the meconium) received in the womb. This circumstance induced Drelincourt, and some other anatomists, to think, that the acrimony and uneasiness, arising from an accumulation of excrement in the bowels, is the reason why they become restless, and use every effort to escape from the womb. I am not, I acknowledge, more satisfied with this explication than the others. If the child is pressed with fæces, why does it not evacuate them in the liquor amnii? But this never happens. It appears, on the contrary, that the necessity of evacuating the meconium is not felt till after birth, when the motion of the diaphragm, occasioned by respiration, compresses the intestines, and gives rise to this evacution; especially since no meconium was found in the amnios of a fœtus of ten months, who had not respired, and since an infant of six or seven months discharges the meconium soon after respiration.

Other anatomists, and particularly Fabricius ab Aquapendente, imagined that the fœtus left the uterus from a desire of being refreshed by respiration. But this cause seems to be as chimerical as any that has been mentioned. It is impossible that a fœtus can have any idea of respiration; and far less can it have any conception whether respiration would be agreeable or disagreeable.

After considering all these hypotheses, I suspect that the delivery of the fœtus depends on a cause of a very different nature. The menstrual flux returns at stated intervals. Though its appearance be interrupted by impregnation, its cause is not destroyed; and, though no blood is exhibited at the accustomed period, yet a revolution in the system, similar to what happens before impregnation, must take place. It is for this reason, that, in some women, the menses are not entirely suppressed during the first two or three months after conception. I imagine, therefore, that this periodic revolution happens as regularly after a woman has conceived as before, but that the blood is prevented from flowing, because the excretories of the uterus are swelled and shut up, unless when it arrives in such large quantities, and acts with such force, as to overcome the resistance with which it is opposed. In this case, a great quantity of blood rushes out, and an abortion is the consequence. But it frequently happens, that a small quantity of blood appears, without producing this effect; because the blood has only been able to open a few of the canals or excretories of the uterus, while the rest remain entirely obstructed.

Though no blood appears, which is generally the case, the first revolution fails not to be accompanied with the same painful symptoms. During the first suppression of the menses, therefore, the uterus is affected with a considerable agitation, which, when a little augmented, entirely destroys the product of generation. Hence we may reasonably conclude, that few of those conceptions,

which happen a short time before the accustomed return of the menses, are successful; because the action of the menstrual blood easily destroys the feeble roots of a germ so tender and so delicate. Those conceptions, on the contrary, which take place immediately after this periodic discharge, succeed much better; because the fœtus is allowed more time to grow, and to fortify itself against the action of the blood, when the next revolution happens in the system.

After the fœtus has been enabled to resist the action of the first revolution, the increase of its growth, and of its attachment to the uterus, render it still more capable of resisting any of the subsequent revolutions: abortions, indeed, sometimes happen during every revolution; but they are more rare in the middle of the period of gestation than either at the beginning or near the end. Why they are more frequent at the beginning has already been explained: it only remains to show why they are likewise more frequent towards the end.

The fœtus generally comes into the world during the tenth revolution of the menses. When it is born at the ninth or eighth, it lives, and is not, therefore, regarded as an abortion. Some have pretended to have seen instances of children born at the seventh, and even at the sixth revolution, who, notwithstanding this unfavourable circumstance, continued to live. There is no difference between abortion and birth, but what relates to the living powers of the child. In general, the number of abortions in the first, second, and third months, for the reasons already assigned, is very great; and the number of premature births, in the seventh and eighth months, is also very great, in proportion to the abortions of the fourth, fifth, and sixth months; because, during this middle term of gestation, the product of generation having acquired strength and solidity sufficient to resist the action of the first four periodic revolutions, a more violent effort than any of the former is necessary to destroy the fœtus. For the same reason, an abortion is more difficult during the fifth and sixth months. But the fœtus, which till now was weak, and could exert its own force only in a feeble manner, begins to move with more vigour; and, when the eighth revolution takes place, the efforts of the fœtus, uniting with those of the uterus, and facilitating its exclusion, the fœtus may come into the world in the seventh month, and be in a capacity of living, whenever it happens to be unusually strong at this period. But, if the fœtus be excluded solely from a weakness of the uterus, which renders it unable to resist the action of the blood during the eighth revolution, the birth of it is considered as an abortion, and the child dies. But such cases are uncommon; for, if the fœtus has resisted the first seven revolutions, nothing but particular accidents can prevent it from resisting the eighth, unless it has acquired more vigour than is common at this period. A fœtus which has acquired the same degree of strength, but at a later period, will be excluded at the ninth revolution; and those which require nine months in obtaining this degree of strength, will be born at the tenth revolution, which is the most usual term. But, when the fœtus acquires not this degree of strength and perfection in nine months, it will remain in the uterus till the eleventh, or even the twelfth revolution, that is, till the tenth or eleventh month: of such late births many examples are recorded.

Other reasons, to confirm the opinion, that the menstrual flux is the occasional cause of births at different periods may be produced. The females of all animals which have no menses bring forth very nearly at the same terms: the difference in the times of gestation is extremely small. We may, therefore, conclude, that this variation, which is very great in women, proceeds from the action of the menstrual blood, which is exerted at every periodic revolution.

We have already remarked, that the placenta adheres to the uterus by the papillæ only; that there is no blood either in these papillæ, or in the lacunæ in which they are inserted; and that, when they are separated, an operation which requires no great effort, a milky liquor only issues from them. Why, therefore, is the birth of a child uniformly followed by a considerable hæmorrhage, first of pure blood, and afterwards of blood mixed with a watery fluid? This blood proceeds not from the separation of the placenta; for the papillæ are drawn out of the lacunæ without any effusion of blood. Delivery, therefore, which is nothing more than this separation ought to produce no hæmorrhage. Is it not more natural, on the contrary, to think, that the action of the blood is the cause of the birth; and that it is this menstrual blood alone which forces the vessels of the empty uterus, and begins to flow immediately after delivery, in the same manner as it did before conception?

We know, that, for some time after conception, the sac which contains the product of generation, adheres not to the uterus. We have seen, from the experiments of De Graaff, that, by blowing upon the small globule, it changes its position. The adhesion to the uterus is never very strong: in the early periods of gestation, the placenta is slightly applied to the uterus; and these parts are only contiguous, or joined by a mucilaginous matter, which has hardly any adhesion. How, then, should it happen, that, in abortions of the first or second month, this globule never escapes without being attended with a great effusion of blood? This effusion cannot be occasioned by the passage of the globule, which has no adhesion to the uterus. It is by the action of the blood, on the contrary, that the globule is extruded. Should we not, therefore, conclude, that this is the menstrual blood, which, by forcing the canals through which it was accustomed to flow before impregnation, destroys

the product of conception, and resumes its ordinary course?

The pains of child-bearing are principally occasioned by this action of the blood; for, it is well known, that they are equally violent in abortions of two or three months, as in ordinary births; and that many women feel, without having conceived, very acute pains, whenever the menstrual flux is about to appear. These pains are of the same kind with those which accompany abortions or births. Ought we not, therefore, to ascribe them to the same cause?

It appears, then, that the periodic revolution of the menstrual blood has great influence in child-bearing, and that it is the cause why the terms of delivery in women are more various than in other animals which are not subject to this discharge, and which always bring forth at the same times. It is also apparent, that the revolution occasioned by the action of the menstrual blood is not the only cause of birth: the action of the fœtus itself contributes greatly to this end; for there are instances of children having made their escape from the uterus after the death of the mother, which could only happen from an exertion peculiar to the fœtus.

The terms of gestation in cows, sheep, and other animals, are always the same, and no hæmorrhage attends their delivery. May we not, therefore, conclude, that the blood discharged by women after delivery is the menstrual blood, and that the action of this blood upon the uterus, during every periodic revolution, is the reason why the human fœtus is excluded at so many different terms? It is natural to imagine, that, if the females of viviparous animals had menses like women, their deliveries would be followed by an effusion of blood, and be equally various in their terms. The fœtuses of animals are brought forth covered with their membranes; and it is seldom that the membranes are broken, or the waters flow before delivery. But the birth of a child, with its membranes entire, is a rare phænomenon. This circumstance seems to evince that human fœtuses make greater efforts to escape from their prison than those of other animals, or that the uterus of a woman affords not so free a passage to the child; for it is by the struggles of the fœtus against the resistance it meets with at the orifice of the uterus, that the membranes are torn.

RECAPITULATION.

ALL animals are nourished by vegetables, or by other animals which feed upon vegetables. There is, therefore, in Nature, a matter common to both, which serves for the growth and nourishment of every thing that lives or vegetates. This matter can have no other mode of effecting growth and nourishment, but by assimilating itself to every part of the animal or vegetable, and by intimately penetrating the texture and *form* of these parts, which I have distinguished by the appellation of an *internal mould*. When this nutritive matter abounds more than is sufficient for the growth and expansion of the animal or vegetable, it is detached from all parts of the body, and deposited in one or several reservoirs, under the form of a fluid. This fluid contains all the particles which are analogous to the different parts of the body, and, of course, all that is necessary for the reproduction of a being in miniature perfectly similar to the first. In most animals, this superfluity of nutritive matter does not take place till they have nearly acquired their full growth; and hence it is that animals are not capable of generating before this period.

When this nutritive and prolific matter, which is universally diffused, has passed through the internal mould of an animal or vegetable, and has found a proper matrix, it produces an animal or vegetable of the same species. But, when it finds not a suitable matrix, it produces organized beings different from animals or vegetables, as the moving and vegetating bodies which appear in the seminal fluids of animals, and in the infusions of the buds of plants, &c.

This prolific matter is composed of organic particles, which are always active, whose motions and actions are fixed or arrested by the brute parts of matter in general, and particularly by oily and saline substances; but, as soon as they are disengaged from this matter, which is foreign to their nature, they resume their action, and produce different species of plants, and other animated beings.

The effects of this prolific matter may be seen by the microscope in the seminal fluids of both male and female animals. The semen of viviparous females is filtrated through the glandulous bodies which grow upon their testicles; and these glandulous bodies contain a considerable quantity of seminal fluid in their cavities. Ovi-

parous females, as well as the viviparous, have a seminal fluid, which is still more active than that of the viviparous. The semen of the female is, in general, similar to that of the male, when both are in a natural state. They decompose in the same manner; they contain similar organic particles; and they exhibit the very same appearances.

All animal and vegetable substances contain a great quantity of this organic and prolific matter. To discover it, we have only to separate it from the brute matter in which it is entangled; and this operation is effected by infusing animal or vegetable substances in water: the salts melt; the oils separate; and the organic particles become evident by their movements. They abound more in the seminal fluid than in any other parts of animals; or rather, they are there more disengaged from the brute matter. Soon after flesh is infused, and while it is only slightly dissolved, the organic matter appears under the form of moving bodies, which are nearly as large as those in the seminal fluid. But, in proportion to the increase of the dissolution, the size of the organic particles is diminished, and their motion is augmented; and, when the flesh is entirely decomposed or corrupted, the organic particles are extremely minute, and their motion is inconceivably rapid. It is then that this matter may be poisonous, like that of the viper's tooth, in which Mr. Mead perceived an infinite number of small pointed bodies, and which he imagined to be salts, though they are nothing but these same organic particles in an extremely active state. The pus which proceeds from wounds may acquire such a degree of putrescency, as to become a poison of the most active kind; for, whenever this active matter is exalted to a certain point, which may always be distinguished by the rapidity and minuteness of the moving bodies it contains, it must become a species of poison. The same thing may be remarked with regard to the poison of vegetables. The same matter which nourishes us while in a natural state, will destroy us when it is corrupted, as appears from the gangrenes which affect the limbs of men and other animals, when they are fed with corrupted grain; and from comparing the residue of the food which adheres to our teeth, with that which proceeds from the teeth of the viper or of a mad dog, which is nothing but the same matter too much exalted, and in the highest state of putrefaction.

When large quantities of this organic and prolific matter are collected in some part of an animal, where it is obliged to remain, it there forms living beings, which we have always regarded as real animals. The tænia, the ascarides, all the worms found in the veins, in the liver, in wounds, in pus, and most of those which are formed in putrified flesh, have no other origin. The eels in paste, in vinegar, and all the pretended microscopic animals, are only different forms assumed, according to circumstances, by this active matter, which has a perpetual tendency to organization.

In infusions of all animal and vegetable substances, this prolific matter first discovers itself under the form of vegetation: we see it form into filaments, which grow and expand like plants; then their extremities and joints swell and burst to give passage to the multitude of moving bodies which have the semblance of animals. Nature, it would appear, begins all her operations by a kind of vegetable motion: this motion we perceive in a variety of microscopic objects, and in the expansion of the animal embryo; for a fœtus, at first, possesses only a species of vegetable growth or motion.

Sound food furnishes none of these moving particles for a considerable time: fresh meat, grain, fruits, &c. require some days infusion before they exhibit any moving bodies. But the more any matter is corrupted, decomposed, or exalted, as pus, blighted grain, honey, the seminal fluids, &c. these moving bodies make their appearance the sooner. In seminal fluids, they are entirely free from other matter; and only a few hours infusion are necessary to discover them in pus, corrupted grain, honey, strong drugs, &c.

The existence, therefore, of an organic animated matter, universally diffused through all animal and vegetable substances, and which equally serves for their nourishment, their growth, and their reproduction, is apparent. Nutrition is effected by the intimate penetration of this matter through every part of animal or vegetable bodies; expansion, or growth, is only a more extensive species of nutrition, which proceeds as long as the parts are ductile, and capable of being stretched; and reproduction is an effect of the same matter, when it superabounds in the body of an animal or vegetable. Every part of organized bodies sends off to proper reservoirs the organic particles which are superfluous for its nourishment: these particles are perfectly similar to the different parts from which they are detached, because they were destined for the nourishment of those parts. Hence, when the whole particles sent off from every part of the body are assembled, they must necessarily form a small body similar to the original, because every particle is similar to the part from which it was detached. It is in this manner that every species of reproduction, where only one individual is requisite, as that of trees, plants, polypi, vine-fretters, &c. is effected. This is also the first method employed by nature for the reproduction of such animals as require the aid of different sexes; for the seminal fluid of each sex contains all the particles necessary for reproduction: but, to complete the operation, something more is requisite, namely, the mixture of both fluids in a place suited to the expansion and growth of the fœtus; and this place is the uterus of the female.

There are, therefore, no pre-existing germs, or germs

infinitely contained within each other. But there is an organic matter diffused through all animated nature, which is always active, always tending to form, to assimilate, and to produce beings similar to those which receive it. The species of animals and of vegetables, therefore, can never be exhausted: as long as individuals subsist, the different species will be constantly new; they are the same now that they were three thousand years ago: the whole will perpetually exist by their own powers, unless they be annihilated by the will of their Creator.

THE NATURAL HISTORY OF MAN.

SECTION I.

Of the Nature of Man.

THOUGH man be much interested in obtaining a knowledge of himself, yet I suspect that he is better acquainted with every other object. Endowed by nature with organs destined solely for our own preservation, we employ them for the reception of external impressions only. Anxious to expand our external existence beyond the limits of our powers, and to multiply the functions of our senses, we seldom employ that internal sense which reduces us to our true dimensions, and distinguishes us from every other being. If, however, we are desirous of knowing ourselves, we must cultivate this sense, by which alone we are enabled to form a dispassionate judgment concerning our nature and condition. But how shall we give to this sense its full extent and activity? How shall we emancipate the soul, in which it resides, from all the illusions of fancy? We have lost the habit of employing this sense; its activity is repressed by the tumult of corporeal sensations, and parched with the heat of our passions; the heart, the imagination, the senses, all conspire to annihilate its exertions. Unchangeable, however, in its nature, and invulnerable by its essence, it continues always the same. Its splendour may be obscured, without losing its force; it may enlighten us less, but it guides us with certainty. Let us collect those rays which it still emits, and the darkness which surrounds us will diminish; and, though the path should not be equally illuminated from one end to the other, we shall at least have a torch to prevent us from wandering.

The first and most difficult step, in arriving at a proper knowledge of ourselves, is to acquire distinct ideas of the two subtances of which we are composed. Simply to affirm, that the one is immaterial, unextended, and immortal, and that the other is material, extended, and mortal, is only denying those qualities to the one, which we know the other possesses. What real knowledge can be acquired from this mode of negation? Such negative expressions can communicate no positive idea. But, to say that we are certain of the existence of the former, and less assured of that of the latter; that the substance of the one is simple, indivisible, and has no form; because it manifests itself only by a single modification, which is that of thought; that the other is less a substance, than a subject capable of receiving species of forms relative to our senses, which are all as uncertain and as variable as the organs themselves, is advancing one step towards a distinct idea of the nature of the two substances: it is ascribing to both different and peculiar properties; it assigns to them positive qualities, and enables us to institute a comparison between them.

All our knowledge is ultimately derived from comparison. What is absolutely incomparable must be incomprehensible. Of this God is the only example: he cannot be comprehended, because he can be compared with no other being. But every thing which is susceptible of being compared, and of being relatively viewed in different lights, becomes a source of human knowledge. The more subjects of comparison which any object affords, the means of forming a proper knowledge concerning it are proportionally increased and facilitated.

The existence of the soul is self-evident: to be, and to think, are, with regard to us, the same thing. This truth is more than intuitive: it is independent of the senses, of the imagination, of the memory, and of all our other relative faculties. But the existence of our bodies, and of external objects, is doubtful to every unprejudiced reasoner; for that extension in length, breadth, and thickness, which we call our bodies, and which seem to be so intimately connected with us, is

nothing more than a relation of our senses; and the organs of sensation themselves are only certain affinities with the objects which affect them. Has the internal sense, the mind, any thing common or similar to these organs? Have the sensations produced by light or sound any resemblance to that subtile fluid which excites the idea of light, or to the vibration of the air which conveys to us the notion of sound? These effects result solely from the necessary and intimate relation that subsists between the eyes and ears and the different matters which act upon them. But, as we have demonstrated, that there is no resemblance between sensations and the objects which produce them, is not this a sufficient proof that the nature of the soul is different from that of matter?

We may, therefore, consider it as an established point, that internal sensation is totally different from its cause; and we have already shown, that, if external objects exist, they must be very different from the ideas we form of them; because sensation has not the most distant resemblance to the objects by which it is excited. May we not hence conclude, that the causes of our sensations necessarily differ from our notions concerning them? That extension which we perceive by the eye, that impenetrability of which we acquire the idea by touching, and all the other constituent properties of matter, may have no existence; since our internal sensations of extension, impenetrability, &c. are neither extended nor impenetrable, and possess nothing in common with these qualities.

As the mind, during sleep, is affected with sensations which are often different from those excited by the actual presence of the objects, is it not natural to think, that the presence of objects is not necessary to the existence of our sensations, and, consequently, that both mind and body may exist independent of these objects? For, during sleep and after death, the body has the same existence as before, though the mind recognises not this existence, and, with regard to us, the body entirely loses its being. Now I ask, if any object that can exist, and afterwards be no more, which affects us in a manner totally different from what it is, and from what it has been, can be so real as to leave no doubt of its existence?

We may, still, however, believe, though we are uncertain, that something exists without us; but we cannot hesitate concerning the real existence of every thing within us. The existence of the soul, therefore, is certain, and that of the body seems to be doubtful. The mind has one mode of perception when we sleep, and another when we are awake; after death, she will perceive in a manner still more different; and the objects of sensation, or matter in general, may then have no more existence with regard to her, than our bodies, with which we have no farther connection.

But, though we admit the existence of matter, and that it exists in the very manner we perceive it; yet, in comparing it with the mind, we shall find the latter endowed with qualities so opposite, that we cannot hesitate concerning the difference of its nature and the superiority of its rank.

It is impossible to recognise the mind under any other form than that of thinking, which is extremely general, simple, and uniform. This form is not divisible, extended, impenetrable, nor possesses any other quality of matter. The mind, therefore, which is the subject of this form, must be indivisible and immaterial. Our bodies, on the contrary, as well as all external objects, have many forms, each of which is compounded, divisible, and destructible; and the whole are only relative to the different organs by which we perceive them. Our bodies, and matter in general, therefore, possess no constant, real, or universal properties, which can enable us to acquire a certainty of their existence. A blind man has no idea of the images of bodies presented to us by means of light. A leper, whose skin was insensible, could have none of those ideas which originate from the sense of feeling. A deaf man knows nothing of sound. Supposing a person to be successively deprived of these three instruments of sensation, the mind would still exist, and manifest itself by its own internal power of thinking. But, if you abstract colour, extension, solidity, and all the other qualities of matter which have a relation to our senses, matter, in this case, would be entirely annihilated: the mind, therefore, is indestructible; but matter may, and must perish.

The same reasoning applies to the other faculties of the mind, when compared with the most essential properties of matter. The mind wills and commands; the body obeys as far as it is able: the mind can unite itself, in an instant, to the most distant or most elevated objects; and nothing can prevent this union, when she commands it to be effected. But the body is incapable of uniting with any object; it is wounded by every thing that makes too close an approach. Every thing resists and becomes an obstacle to its motions, which are naturally slow. Is this will, then, nothing more than a corporeal movement; and is contemplation only a a simple contact? How could this contact be effected with remote objects, or abstract subjects? Or how could this motion be instantaneously accomplished? Without space and time, the idea of motion is inconceivable. The will, therefore, if it be a motion, is not a material motion; and, if the union of the mind with its object be a contact, it must be a contact, or rather an intimate penetration at a distance! qualities which are the reverse of those of matter, and which, of course, can belong only to an immaterial being.

But I am apprehensive of having dwelt too long upon a subject, which by some, may be regarded as foreign to the nature of this work. What connection, it may

be said, have metaphysical remarks on the mind with natural history? If I were conscious of abilities sufficient for the discussion of a topic so elevated and extensive, this reflection, I acknowledge, would not give me any uneasiness; and I have abridged my observations, solely because I despaired of being able to comprehend a subject so immense, and so important in its nature. Why should the noblest part of man be rejected from his history? Why thus preposterously debase him, by considering him merely as an animal, while his nature is so different, and so superior to that of the brutes, that nothing but the most brutal ignorance could ever dream of confounding them?

Man, it is true, resembles the other animals in the material part of his being; and, in the enumeration of natural existences, we are obliged to rank him in the class of animals. But, in nature, there are neither classes nor genera; all are mere independent individuals. Classes and genera are only the arbitrary operations of our own fancy: and, though we place man in one of these classes, we change not his nature; we derogate not from his dignity; we alter not his real condition; we only assign him the first rank among beings which resemble him solely in the material part of his existence.

When we compare man with the animal creation, we find in both a material organized body, senses, flesh and blood, motion, and many other striking resemblances. But all these analogies are external, and authorise us not to pronounce, that the nature of man is similar to that of the brute. In order to acquire a distinct idea concerning the nature of each, it is necessary that we should have as complete a knowledge of the internal qualities of animals as we have of our own. But, as it is impossible to know what passes within animals, or how to rank or estimate their sensations, in relation to those of man, we can only judge by comparing the effects which result from the natural operations of both.

Let us, therefore, consider these effects; and, while we acknowledge all the particular resemblances, we shall only examine some of the most general distinctions. The most stupid man, it will be admitted, is able to manage the most alert and sagacious animal: he governs it, and makes it subservient to his purposes. This he effects not so much by strength or address, as by the superiority of his nature. He compells the animal to obey him, by his being possessed of reason, which enables him to project and to act in a systematic manner. The strongest and most sagacious animals have not the capacity of commanding the inferior tribes, or of reducing them to a state of servitude. The stronger, indeed, devour the weaker: but this action implies an urgent necessity only, and a voracious appetite, qualities very different from that which produces a train of actions all directed to one common design. If animals be endowed with this faculty, why do not some of them assume the reins of government over others, and force them to furnish their food, to watch over them, and to relieve them when sick or wounded? But, among animals, there is no mark of subordination, nor the least trace of any of them being able to recognize or feel a superiority in his nature above that of other species. We should, therefore, conclude, that all animals are of the same nature, and that the nature of man is not only far superior, but likewise of a very different kind from that of the brute.

Man exhibits, by external signs, what passes within him. He communicates his sentiments by words; and this sign is universal. The savage and the civilized man have the same powers of utterance; both speak naturally, and are equally understood. It is not owing, as some have imagined, to a defect in their organs, that animals are denied the faculty of speech. The tongue of a monkey has been discovered by anatomists to be as perfect as that of a man. The monkey, therefore, would speak, if it could think. If the train of its thoughts were analogous to that of ours, it would speak the language of men; and supposing the order and manner of its thinking to be peculiar to the species, it would still speak a language intelligible to its neighbours. But apes have never been discovered conversing together. Instead, therefore, of thinking in a manner analogous to man, they seem not to have the smallest order or train in their thoughts. As they express nothing that exhibits combination or arrangement, it follows, either that they do not think, or that the limits of their thinking are extremely narrow.

As several species of animals are capable of being taught to pronounce words, and even to repeat sentences, this is an invincible proof that the want of speech among them is not owing to any defect in their organs. Many other brutes might, perhaps, be taught to articulate words; but, to make them conceive the ideas which these words express, is beyond the power of art. They seem to articulate and to repeat merely like an echo or a machine. They are defective, not in the mechanism of their organs, but in their intellectual powers.

Language implies a train of thinking; and it is for this reason that brute animals are incapable of speech: for, though we should allow them to possess something similar to our first apprehensions, and to our most gross and mechanical sensations, it is certain that they are unable to form that association of ideas in which alone the essence of reflection and of thought consists. They can neither think nor speak, because they can neither join nor separate ideas; and, for the same reason, they neither invent nor bring any thing to perfection. If they were endowed with the power of reflecting, even in the slightest degree, they would be capable of making some progress, and acquire more industry; the present race of beavers would build their houses with more

art and solidity than their progenitors; and the bee would daily improve the cell which she inhabits: for, by supposing that this cell has all the perfection of which it is capable, we ascribe to this insect a genius and understanding superior to the human, by which it is enabled, at one glance, to perceive the utmost point of perfection to which its work can be carried. But man never can attain a clear view of this point: much time, reflection, and practice, are necessary, before the meanest of our arts can be brought to maturity.

Whence proceeds this uniformity in all the operations of animals? why does every species perform the same work in the very same manner? and why is the execution of different individuals neither better nor worse than that of every other? can there be a stronger proof that their operations are only the results of pure mechanical impulse? if they possessed a single spark of that inward light which illuminates mankind, we should find variety, at least, if not perfection, in their works; every individual would exhibit some difference in his mode of execution. But such differences never appear: they all work upon the same plan; their mode of acting runs through the whole species, and is not peculiar to any individual: if, therefore, we ascribe to animals a mind or soul, we must allow but one to every species, of which each individual has an equal share: this soul would, of course, be divisible, and, consequently, material, and very different from ours.

Why, on the contrary, is so much variety exhibited in the operations of men? why does servile imitation cost us more labour than original design? because our souls are proper to us, and independent of any other; and because we possess nothing common to the species, but the matter which constitutes our bodies, and by which alone we have any resemblance to the brute creation.

If internal sensation depended on corporeal organs, should not as great a variety appear in the operations of the same species of animals, as in those of men? would not those endowed with finer organs build their nests, and their cells, in a manner more solid, elegant, and commodious? if any individual had more genius than another, would it not be rendered conspicuous by its mode of acting? but nothing of this kind is ever exhibited: the greater or lesser perfection of corporeal organs, therefore, has no influence upon the nature of internal sensation. From this circumstance, we may safely conclude, that animals possess no sensations of this kind; that they neither belong to matter, nor depend, as to their nature, upon the texture of corporeal organs; and of course that there is in man a substance totally distinct from matter, which is the subject and the cause that produce these sensations.

But these proofs of the immateriality of the human mind may be extended still farther. We have often remarked, that Nature proceeds in her operations by imperceptible degrees. This truth, which otherwise admits of no exception, is here totally reversed. Between the faculties of man and those of the most minute animal, the distance is infinite. This is a clear proof, that the nature of man is different from that of the brute creation; that he himself constitutes a separate class from which there are numberless degrees of descent, before we arrive at the state of the mere animal; for, if man were of the same rank with the animals, there would be in nature a certain number of beings less perfect than man, and superior to any animal we are acquainted with; and those intermediate beings would descend imperceptibly from man to the monkey tribes. But no such beings exist. The passage is sudden from a thinking being to a material one, from intellectual faculties to mechanical powers, from order and design to blind impulse, from reflection and choice to ungovernable appetite.

This is a strong indication of the excellence of our nature, and of the immense distance fixed by the bounty of the Creator between men and animals. Man is a reasoning being; the animal is totally deprived of that noble faculty: and as there is no intermediate point between a positive and a negative, between a rational and an irrational animal, it is evident that man's nature is entirely different from that of the animal; that the latter only resembles the former in the external or material part; and that, to form a judgment from this material resemblance alone, is shutting our eyes voluntarily against that light which enables us to distinguish truth from falsehood.

Having considered the internal nature of man, and demonstrated the immateriality of his soul, we shall next examine his external part, and give the history of his body. In the preceding chapters, we have explained his formation and expansion, and traced him to the very moment of his birth: let us now run over the different ages of his life; and, after conducting him to that period when he is separated from his body, we shall leave it to moulder in the common mass of matter to which it originally belonged.

SECTION II.

Of Infancy.

NOTHING exhibits such a striking picture of weakness, of pain, and of misery, as the condition of an infant immediately after birth. Incapable of employing its organs or its senses, the infant requires every kind of succour and assistance: it is more helpless than the young of any other animal: its uncertain life seems every moment to vibrate on the borders of death. It can neither move nor support its body: it has hardly force enough to exist, and to announce, by groans, the pain which it suffers; as if Nature intended to apprise the little innocent, that it is born to misery, and that it is to be ranked among human creatures only to partake of their infirmities and of their afflictions.

Let us not disdain to consider that state in which our existence commenced: let us view human nature in the cradle; and, leaving the disgust that might arise from a detail of the cares which infancy demands, let us inquire by what degrees this delicate and hardly existing machine acquires motion, consistency, and strength.

An infant, at birth, passes from one element into another. When it escapes from the waters which surrounded it in the womb of the mother, it is exposed to the air, and instantly feels the impressions of that active fluid. The air acts upon the olfactory nerves, and upon the organs of respiration. This action produces a shock, a kind of sneezing, which expands the chest, and gives the air a free passage into the lungs, the vesicles of which it dilates. After the air remains for some time, it is heated and rarified to a certain degree, and the stimulus or spring arising from the dilatation of the fibres re-acts upon this rarified fluid, and expels it from the lungs. We will not here attempt to explain the causes of the alternate motion of respiration, but shall confine ourselves to its effects.

This function is essentially necessary to the existence of man and of many other animals. If respiration ceases, the animal must perish; when once commenced, it never stops till death; and, after the fœtus begins to respire, it continues this action without interruption. It is probable, however, that the foramen ovale of the heart does not close immediately after birth, and, consequently, that part of the blood must pass through that aperture. The whole blood, therefore, enters not, at first, into the lungs; and a new-born child may perhaps be deprived of air for a considerable time without suffocation. This conjecture seems to be confirmed by some experiments I lately made upon young dogs. I procured a pregnant bitch, of the large greyhound kind, and, when just about to litter, I fixed her so in a bucket full of warm water, that her hinder parts were entirely covered. In this situation she brought forth three puppies, which, after being disengaged from their membranes, were immersed in a fluid nearly of an equal temperature with that of the amnios. After assisting the mother, and washing the puppies in this water, I suddenly removed them into a pail of warm milk, without allowing them time to respire. I put them into the milk, in preference to water, that they might have an opportunity of taking some food, if they found a desire for nourishment. I kept them immersed in the milk for more than half an hour; and, when taken out of it, all the three were alive. They began to breathe; and they discharged a quantity of fluid matter by the mouth. I allowed them to respire about half an hour, and again immersed them in the warm milk, where they remained another half hour. I then took them out: two of them were still vigorous; but the third seemed to languish; I therefore ordered it to be carried to the mother, which, beside the three brought forth in the water, had littered other six in the natural manner. The puppy which was born in the water, and had continued one half hour in warm milk, before it was allowed to breathe, and another half hour after it had respired, seemed to be very little incommoded; for it soon recovered, and was as active and lively as those which had received no injury. Of the six that were brought forth in the air, I threw away four; so that there remained only two with the mother, beside the one that had been littered in the water. I continued my experiments upon the other two which had been twice immersed in the milk: after allowing them to breathe about half an hour, I plunged them a third time into the milk, where they remained another half hour. Whether they swallowed any of the milk, I could not determine; but, when removed, they appeared to be nearly as vigorous as before their immersion. Having carried them, to the mother, however, one of them died that same day; but I know not whether its death was owing to some accident, or to the injury it received from being plunged into the milk, and deprived of air. The other lived as well as the first; and both grew up,

and were equally vigorous as those which had not been subjected to the experiment. I pushed these trials no farther: but I learned enough to convince me, that respiration is not so indispensably necessary to the existence of a new-born animal, as to an adult; and that, by employing certain precautions, it is, perhaps, possible to keep the foramen ovale open, and, by this means, produce excellent divers, or a species of amphibious animals, which would be able to live equally in air or in water.

The air, on its first entrance into the lungs, generally meets with some obstacle, occasioned by a fluid substance collected in the wind-pipe. This obstacle is greater or less, in proportion to the viscidness of the liquor. But the infant, at birth, raises its head, which formerly reclined on its breast; and, by this operation, the canal of the wind-pipe is lengthened; the air, of course, rushes in, forces this fluid into the cells of the lungs, which it dilates; and in this manner, the mucous substance, which opposed the free passage of the air, is diffused through the whole substance of the lungs. The perpetual admission of fresh air soon dries up this superfluous moisture; or, if it should still incommode the infant, it excites a cough, and is thrown off by expectoration, which generally runs out of the mouth, because the child has not yet strength enough to spit.

We can remember nothing that passes at this early period of our existence. It is, therefore, impossible to discover the feelings produced in the child by the first impressions of the air. But the cries and groans it utters immediately after birth, are certain indications of the pain occasioned by the action of the atmosphere. Till the moment of birth, the infant is accustomed to the mild warmth of a tranquil fluid. It is, therefore, consonant to reason, that the action of a fluid, unequal in its temperature, is too violent for the lax and delicate fibres of a new-born infant. It is equally sensible of heat as of cold: in every situation it utters complaints; and pain appears to be its first and only sensation.

Most animals are blind for some days after birth. Infants open their eyes the moment they come into the world; but their eyes are fixed and dull: they have not that lustre and brilliancy they afterwards acquire; neither have they those motions which accompany distinct vision. But they seem to feel the impression of light; for the pupil contracts or dilates, in proportion to the quantity of light. A new-born infant cannot distinguish objects; because the organs of vision are still imperfect: the cornea is wrinkled; and perhaps the retina is too soft and lax for receiving the impressions of external bodies, and for producing the sensations peculiar to distinct vision.

The same remark may be applied to the other senses. They have not yet acquired that force and consistency which the operation of the senses demand: and, even when they arrive at this state, it is long before the sensations of the infant can be just and complete. The senses are instruments of which we must gradually learn the use. That of vision is the most noble, and the most wonderful; but, at the same time, it is the most uncertain and elusory. The sensations produced by it, if not rectified every moment by the sense of touching, would uniformly lead us into false conclusions. The sense of touching is the criterion of all the other senses: it alone is essential to animal existence, and is universally diffused through every part of the body. But even this sense is imperfect at birth: a new-born infant, indeed, discovers symptoms of pain by its cries and its groans; but it has no expression that indicates pleasure. It begins not to smile in less than 40 days: it is about this time, likewise, that it begins to weep; for its former cries were not accompanied with tears. There are no vestiges of the passions in the countenance of a new-born child. The features of the face have not acquired that consistence and elasticity which are necessary for expressing the sentiments of the mind. All the other parts of the infant's body are extremely feeble; and their motions are aukward and ill-directed. It is unable to stand erect; its thighs and legs are still bended, from the habit contracted while in the womb of the mother; it has not strength to stretch out its arms, or to lay hold of any thing with its hands; and, if abandoned in this condition, it would remain on its back, without being able to turn to one side or another.

From these remarks, it appears, that the pain felt by infants recently born, and which they express by crying, is only a corporeal sensation, similar to that of other animals, who likewise cry the moment they are brought forth; and that mental sensation commences not sooner than 40 days after birth; for smiles and tears are the effects of two internal sensations, which both depend upon the action of the mind. The former is an agreeable sensation, which originates from the sight or remembrance of a known and desirable object: the latter is a disagreeable agitation, compounded of sympathy and anxiety concerning our own welfare. Both these passions presuppose a certain degree of knowledge, and a power of reflecting, and of comparing ideas. Smiles and tears are expressions of pleasure and pain peculiar to the human species; for the cries, the motions, and the other marks of bodily pains and pleasures, are common to man and most of the other animals.

But we must now return to the material organs and affections of the body. The size of an infant born at the full time is generally about 21 inches, though some exceed, and others fall much below this standard. The breast of a child of 21 inches, measured by the length of the sternum, is about three inches, and only two, when the infant exceeds not 14 inches in length. At nine months, a fœtus generally weighs from 12 to 14

pounds. The head is large in proportion to the body; but this disproportion gradually wears off, as the infant increases in size. The skin of a new-born child is very fine, and of a reddish colour, its transparency allowing a slight tint of the blood to shine through. It is even alledged, that the redder the skin of an infant is at birth, it will afterwards become the fairer and more beautiful.

The form of the body and members of infants, recently after birth, is by no means perfect. The parts are too much rounded; and even when the child is in high health, they have a swollen appearance. A kind of jaundice generally comes on at the end of three days; and, at the same time, there is milk in the breasts of infants, which is squeezed out by the fingers. As the growth of the child increases, the superfluous juices and swelling of the parts gradually diminish.

In some infants, a palpitation may be seen in the fontanella, or open of the head; and, in every child, the beating of the sinuses, or arteries of the brain, may be felt at this place. Above this opening, a species of scurf appears, which is often very thick, and must be rubbed off with a brush, when it becomes dry. This matter seems to have some analogy to the horns of quadrupeds, which likewise derive their origin from an opening in the skull, and from the substance of the brain. We shall afterwards show, that the extremities of the nerves become solid when exposed to the air; and that horns, nails, claws, &c. are genuine productions of this nervous substance.

The fluid contained in the amnios leaves upon the infant's body a viscid whitish matter, which is sometimes so adhesive, that it requires to be diluted with some mild liquid before it can be removed. In this country, we always wash the infant with warm liquors; but there are whole nations, who inhabit climates much colder than ours, where the infants are plunged into cold water as soon as they are born, without receiving the smallest injury. The Laplanders are even said to leave their new-born infants in the snow till their respiration is almost stopped with cold, and then throw them into a warm bath. This rough treatment is continued three times every day for the first year: and, after that period, the children are bathed thrice a week in cold water. The inhabitants of the northern regions are firmly persuaded that cold bathing makes men more healthy and robust: and therefore, they inure their children to this habit from their very birth. We are, indeed, totally ignorant how far our bodies may be rendered capable of suffering, of acquiring, or of losing, by the power of habit. The savages in the isthmus of America, when covered with sweat, plunge themselves into cold water with impunity: the women throw their drunk husbands into the rivers, in order the more speedily to remove the effects of intoxication: the mothers bathe in cold water along with their infants the moment after they are delivered; and yet much fewer of them die of child-bearing than in other countries, where a practice of this kind would be regarded as extremely dangerous.

Infants, a few minutes after birth, and generally after feeling the heat of a fire, discharge urine, and likewise the meconium or excrement which had been formed in the intestines during their abode in the womb. But this last evacuation does not always happen so soon; and, when it is retarded during the first day, the child is often affected with cholic pains; the discharge must, therefore be promoted by proper remedies. The meconium is black, and when entirely purged off, the stools are of a whitish colour. This change generally happens on the second or third day. The odour of the excrement becomes then more offensive than that of the meconium; which is a proof that the bile, and other bitter humours of the body, begin to be mixed with the fæces.

This observation seems to confirm what was formerly advanced concerning the growth and nourishment of the fœtus. We then remarked, that the fœtus was nourished by absorption, and that it received no food by the mouth. This change in the odour of the excrement is a proof that the stomach and intestines of the fœtus have no action, or, at least, that they act not in the same manner, as after the motions communicated to them by respiration; since it is only after this period that digestion and the mixture of the bile and pancreatic juice with the food, takes place in the stomach and intestines. Thus, though the bile and pancreatic juice are secreted in the fœtus, these liquors remain in their reservoirs, and pass not into the intestines; because, like the stomach, these reservoirs have yet no motion or action sufficient to make them empty their contents into the receptacles of the food.

Before the child is allowed to suck, we allow it time to discharge the slime and meconium in its stomach and bowels. As these substances might sour the milk, and produce bad effects, we first give the child a little wine and sugar, in order to fortify its stomach, and to promote such evacuations as are necessary to prepare it for receiving and digesting its food. Ten or twelve hours, therefore, ought to elapse, before the child be allowed to suck for the first time.

The infant has hardly escaped from the womb of its mother and enjoyed the liberty of stretching its limbs, when it is again condemned to a more cruel and unnatural bondage. The head of the little innocent is fixed; its legs are fettered; its arms are bound down to its sides; and it is laced with bandages so strait, that it cannot move a single joint. It is a fortunate circumstance, when the swaddlings are not drawn so tight as to stop respiration, or when the midwife has the sense to lay the miserable captive on its side, that the natural

moisture may spontaneously flow from its mouth; for it is denied the liberty of turning its head to facilitate this necessary discharge. Is it not an instance of superior wisdom in those nations, who simply clothe their infants, without tormenting them with swaddling bands? The Siamese, the Indians, the Japanese, the Negroes, the savages of Canada, of Virginia, of Brazil, and almost all the inhabitants of South America, lay their infants naked into hanging beds of cotton, or put them into cradles lined with fur. These practices are both sensible and humane: the restraint of swaddling-bands must be painful. The efforts made by infants to disentangle themselves have a more direct tendency to distort their members, than any positions they could assume, if left in the full possession of liberty. Swaddling-bands may be compared to the stays worn by young girls, which occasion many more deformities and diseases than they are intended to prevent.

If the efforts for liberty made by infants thus fettered be hurtful, the inactivity to which they are condemned is, perhaps, still more noxious. The want of exercise retards the growth of their members, and diminishes the strength of their bodies; and, of course, those children who are allowed full freedom of motion will be the most vigorous and healthy. It was this motive that induced the Peruvians to leave the arms of their infants perfectly loose, in a wide swathing-bag: afterwards, when their children grew older, they put them up to the middle in a hole dug out of the earth, and lined with linen; their arms, by this contrivance, were at full liberty; and they could move their heads and bend their bodies, without falling, or hurting themselves. As soon as they were able to step, the breast was presented to them at a little distance, to entice them to walk. The children of Negroes are often exposed to greater difficulties before they can approach the nipple; they cling round one of the mother's haunches with their knees and legs; they adhere so fast, that they support themselves without the assistance of the mother; they lay hold of the breast with their hands; and they continue to suck without inconvenience or danger of falling, though the mother moves about or works at her ordinary labour. These children begin to walk, or rather to creep, on their hands and knees, at the end of the second month; and, by exercise, they acquire the faculty of running, in this situation, with nearly equal quickness as they do upon their feet.

Infants, recently after birth, sleep much; but their sleep is often interrupted. As they likewise require frequent nourishment, they ought to have the breast once every two hours during the day, and, in the night, as often as they awake. At first, they sleep almost continually; and they seem never to awake but when stimulated by hunger or pain: their sleep, therefore, generally terminates by a fit of crying. As in the cradle, they are obliged to lie in the same position, and are chained down by bandages, this situation soon becomes painful. They are besides often wet and chilled by their excrements, the acrimony of which irritates their delicate and sensible skin. In this condition, the efforts of children are extremely feeble; and their calls for relief are expressed by cries and groans. This succour should always be speedily administered; or rather the inconveniencies they feel should be prevented, by frequently changing part of their clothing. The savages are so attentive to this article, that, though they cannot change their furs so often as we do our linen-cloths; yet they supply this defect by employing other substances, of which they have no occasion to be sparing. In North America, they put wood dust, which they obtain from trees that have been corroded by worms, into the bottom of the cradle, and renew it as often as necessary: the children are laid upon this powder, and covered with skins. Though this powder may, perhaps, be as soft as our down-beds; yet they use it not for the purposes of delicacy, but because it quickly absorbs moisture of every kind. In Virginia, they place the child naked upon a board covered with cotton, and provided with a hole for the passage of the excrement. The cold in this country is unfavourable to such a practice; but it is almost general in the east of Europe, and particularly in Turkey. This precaution has another advantage; it precludes all kind of care, and prevents the dreadful effects which too commonly result from the common negligence of nurses. Nothing inferior to maternal affection can support that perpetual vigilance and minute attention which the infantine state requires. With what propriety, then, can such exertions be expected from ignorant and mercenary nurses?

Some nurses desert their children for several hours without feeling the smallest anxiety: others are so callous as not to be affected with their cries. In this situation the unfortunate infants seem to despair; they exert all the force of which they are capable; and their cries only cease when their strength is exhausted. This excessive crying either occasions diseases, or at least throws them into a state of lassitude, which deranges their constitutions, and may have some influence on their tempers. Indolent nurses are guilty of another abuse: instead of employing proper means for pleasing the child, they rock it violently in the cradle. This agitation confuses the brain, stops the crying, and, if long continued, stuns the child into sleep. But this forced and unnatural sleep is only a palliative; it removes not the original cause of complaint. Long and violent rocking, on the contrary, may disorder the stomach and head, and lay the foundation of future disorders.

Before children are put into the cradle we ought to be certain that they want nothing; and they should never be rocked with such violence as to confound or

stun them. If they sleep not sufficiently, a gentle and equal motion may be employed. Neither should they be often rocked; for, if they be once accustomed to this motion, they will not afterwards sleep without it. Though children, when in health, should sleep long without the assistance of art; yet their constitution may be injured by too much sleep. In this case, they should be roused by gentle motion, by soft and agreeable sounds, and by amusing them with brilliant objects. This is the period when they receive the first impressions from the senses, which are, perhaps, of more importance during life than is generally imagined.

Infants always direct their eyes to the lightest part of a room; and if, from the child's situation, one eye only can see the most luminous part, the other, for want of equal exercise, will not acquire equal strength. To prevent this inconvenience, the foot of the cradle, whether the light proceeds from a window or a candle, should be placed opposite to the light: in this position both eyes receive the light at the same time, and consequently acquire, by exercise, an equal degree of strength: if one eye acquires more strength than the other, the child will squint; for I have elsewhere proved, that an inequality of strength in the eyes is the cause of squinting.

For the first two months, the infant should receive no other food than the milk of the mother or nurse; and, if its constitution be delicate, this nourishment alone should be continued during the third and fourth month. A child, however robust, may be injured, if any other food be administered before the end of the first month. In Holland, in Italy, in Turkey, and through the whole Levant, children are allowed no other food during the first year. The savages of Canada nurse their children four or five, and sometimes six or seven years. In our country, as most nurses have not a sufficient quantity of milk to satisfy the desires of their children, in order to spare it, they give them, even from the beginning, a composition of boiled bread and milk. This nourishment appeases hunger; but, as the stomach and intestines are yet too weak to digest such a gross, viscid substance, the children are greatly hurt by it, and often die of indigestion.

The milk of animals, in cases of necessity, may supply that of the mother: but then the child should be obliged to suck the animal's teat, that it may receive the milk in an equal and proper degree of heat, and that, by the action of the muscles in sucking, the milk may be mixed with saliva, which greatly promotes digestion. I have known several peasants who had no other nurses than ewes; and yet they were equally vigorous as those who had been nursed by their mothers.

After two or three months, when the child has acquired some strength, it may have food somewhat more solid, as flour baked with milk, a species of bread which gradually disposes the stomach to receive common bread, and such other nourishment as it must afterwards be accustomed to take.

The consistence of liquid food is thus gradually increased, that the child's stomach may be prepared to receive what is still more solid. Infants, during the first year, are incapable of mastication. The rudiments of the teeth are still covered with the gums, which are so soft, that they can have little effect upon hard substances. Some nurses, especially among the common people, first chew the food, and then give it to their children. Before reflecting on this practice, we must throw aside every idea of disgust, of which children, at this age, have not the least conception. They are equally disposed to receive nourishment from the mouth of the nurse, as from her breasts. This custom seems to have originated from some natural instinct; for we meet with it in many countries which are exceedingly remote from each other; as in Italy, in Turkey, in most parts of Asia, in America, in the Antilles, in Canada, &c. As it is the only way by which the stomachs of children can be supplied with a proper quantity of saliva, I believe it is very useful to them. If the nurse chews a bit of bread, it is soaked in her saliva, which renders it fitter for nourishment than if it had been diluted in any other liquor. This practice, however, is unnecessary after children are furnished with teeth, which enable them to chew their food, and to mix it with their own saliva.

The *incisores*, or cutting teeth, are eight in number, four in each jaw, and they generally appear about the seventh month, though, in some cases, not till the end of the first year. These teeth are often premature; for some children have them at birth, and fœtuses have been found with teeth completely formed long before the ordinary time of gestation is finished.

The rudiments of the teeth are lodged in sockets, and covered with the gums: in the process of their growth, they extend their roots to the bottom of the socket, and break through the gums. This process observes not the ordinary laws of nature, which act continually on the human body, without occasioning any painful sensation. Here nature makes a violent and painful effort, which is often attended with fatal consequences. Children, when teething, lose their usual sprightliness, and become peevish and fretful. The gums are at first red and swelled; and, when the circulation of the blood is nearly stopped by the pressure of the teeth, they turn whitish. Children perpetually apply their fingers to the affected part, in order to remove the irritation: to procure still farther relief, they are furnished with a piece of ivory, coral, or any other hard smooth substance, which they rub against the gums. This operation relaxes the parts, affords a momentary cessation of pain, renders the gums thinner, and facilitates their rupture. But, notwithstanding every precaution, the rupture of the gums

is always accompanied with pain and danger. When the gums are uncommonly strong and rigid, they resist the pressure of the teeth for a considerable time, and occasion a violent inflammation, which often proves fatal. The simple operation of cutting the gum removes the inflammation, and gives a free passage to the teeth.

The canine or dog-teeth, which are four in number, and situated next to the cutting-teeth, generally appear in the ninth or tenth month. About the end of the first, or during the course of the second year, the sixteen molares or grinders, four on each side of the canine-teeth, cut the gums. But these periods vary greatly in different children.

The cutting-teeth, the dog-teeth, and the first four grinders, are generally shed during the fifth, sixth, or seventh year; and are commonly replaced in the seventh year, though sometimes not before the age of puberty. The shedding of these sixteen teeth is occasioned by the expansion of the rudiments of a second set, which are situated at the bottom of the sockets, and, by their growth, push out the first set. But there is no second set below the other grinders; and, therefore, they never shed but by accident, and their loss is seldom repaired.

There are still other four teeth situated at the extremity of each jaw. In some persons, these teeth are entirely wanting: they seldom appear before the age of puberty, and sometimes not till a more advanced period. They are distinguished by the name of *Wisdom-teeth*, and either appear successively, or two at a time. It is owing to this irregularity in the wisdom-teeth, that the number of teeth is not uniformly the same, which varies from 28 to 32. Women, it has been alledged, have generally fewer teeth than men.

Some authors maintain, that the human teeth, like those of certain animals, would continue to grow during life, if they were not constantly worn down by grinding the food. But this notion seems to be contradicted by experience; for people who live upon liquid food have not longer teeth than those who eat the hardest kinds of aliment. Besides, those who hold this opinion probably mistake the tusks of certain animals for their teeth. The tusks of the wild boar, and of the elephant, for example, continue to grow during life; but their increase, after they arrive at their natural size, is extremely doubtful. Tusks have a greater analogy to horns than to teeth: but this is not a proper place for such discussions. We shall only remark, that, in children, the first set of teeth are less solid, and more loosely fixed in their sockets, than the second.

It has been often asserted, that the first hair of children is always brown; and that, after it falls off, it is replaced by hair of different colours. I am unable to determine whether this remark be well founded; but the hair of most children is fair, and often entirely white. In some it is red, and in others black: but in all those who are to have fair or brown complexions, the hair is more or less fair in early infancy. Those who are to be fair have generally blue eyes; those who are to be red have yellowish eyes; and those who are to be brown have eyes of a dark yellowish colour: but these distinctions are imperfectly marked in children recently after birth; because their eyes are then almost always blue.

When infants are allowed to cry long and violently, ruptures are frequently the consequence of the efforts they make. These are easily reduced by the application of bandages. But, if this remedy be too long neglected the disease may continue during life. The limits to which I have prescribed myself permit me not to mention all the diseases incident to children. I shall only remark on this subject, that worms, with which they are often infested, are produced from the nature of their food. Milk is a species of chyle, a purely nutritive substance, without any mixture: it, of course, consists entirely of organic and prolific matter, which, when not properly digested by the stomach, and applied to the nourishment and growth of the body, assumes, by its natural activity, other forms, and produces animated beings, or worms, in such profusion, that the child is often in danger of being destroyed by them. The bad effects occasioned by worms might perhaps be prevented, by allowing children to drink a little wine; because fermented liquors have a tendency to prevent the generation of worms: fermented liquors likewise contain few organic nutritive particles; and it is chiefly by acting on the solids, that wine communicates strength to the body; for it contains little nourishment. Besides, most children are fond of wine; or, at least, they are easily accustomed to drink it.

Though the bodies of infants be extremely delicate, they are less sensible of cold than at any other period of life. Their internal heat, it would appear, is proportionally greater: the quickness of the pulse in children seems to fortify this opinion. Small animals, for the same reason, have unquestionably more heat than large ones; for the action of the heart and arteries increases in proportion to the comparative smallness of animals, which takes place in the same, as well as in different species. The pulse of an infant, or of a little man, is more frequent than that of an adult, or of a large man. The pulse of an ox is slower than that of a man; a dog's pulse is quicker than a man's; and the motion of the heart in very small animals, as that of a sparrow, is so rapid that the strokes can hardly be numbered.

The life of a child, till it be three years of age, is extremely precarious. In the two or three succeeding years, however, its life becomes more certain; and, in the sixth or seventh year, a child has a better chance of

living than at any other period. By consulting Simpson's tables of the degrees of mortality at different ages, it appears, that, of a certain number of children born at the same time, more than a fourth of them died in the first year, more than a third in two years, and at least one half in the first three years. If this calculation be just, when a child is born, we might lay a bet, that it would not live above three years. This exhibits a melancholy view of the human species; for, though a man who dies at the age of 21 is generally lamented, as being prematurely deprived of life; yet, according to these tables, one half of mankind must die before the termination of three years; and, consequently, every man who lives more than three years, instead of complaining of his fate, ought to consider himself as peculiarly favoured by his Creator. But this mortality of children is not nearly so great in every place as in London.

In the growth of the human body, one thing is exceedingly remarkable. The growth of the fœtus increases more and more, in equal times, till it escapes from the womb. The growth of the child, on the contrary, gradually diminishes, in equal times, till the age of puberty, to which it makes a sudden bound, and soon acquires its full stature. The fœtus, at the end of the first month, is an inch long; at the end of the second it is two inches and a quarter; in three months it is three inches and a quarter; in four months it is more than five inches; in five months, it is six and a half, or seven inches; in six months, it is eight and a half, or nine inches; in seven months, it is more than 11 inches; in eight months, it is 14 inches; and in nine months, it is 18 inches. Though these measures vary in different subjects, yet the uniform result is, that the fœtus, in equal times, continues to have a proportionally greater increase. But, if a child at birth be 18 inches long, it will not acquire, for the next 12 months, above six or seven inches more; that is, at the end of the first year, it will be 24 or 25 inches; in two years it will only be 28 or 29 inches; in three years it will be no more than 30, or, at most, 32 inches; and afterwards, till the age of puberty, it will not acquire above one and a half, or two inches, every year. Thus the fœtus grows more in one month, when near the termination of its abode in the uterus, than the child does in one year, till it arrives at the age of puberty, when Nature seems to make a sudden effort to bring her work to maturity.

For preserving the health of children, virtuous and wholesome nurses are of the utmost importance. We have too many melancholy examples of certain diseases being communicated from the nurse to the child, and from the child to the nurse. Whole villages have, in this manner, been infected with the venereal virus.

Children, it is probable, would be much more strong and vigorous, if they were nursed by their mothers, whose milk must be more agreeable to them than that of any other woman; for the fœtus is nourished in the womb with a liquor which has a great resemblance to the milk in the breasts. Thus the infant is, in some measure, accustomed to the milk of the mother, even before its birth. But the milk of another woman is not only new to the child, but is often of so different a nature, that it is difficult to reconcile the child to the use of a stranger's milk. We sometimes see children, who cannot digest the milk of certain women, languish and turn diseased; and, if they are not speedily supplied with another nurse, they soon perish.

Nothing can be more destructive to children than the practice of crowding numbers of them into the same hospital. Most of them die of infectious diseases, which they would certainly escape, if they were brought up in separate houses, and particularly at a distance from great towns. The same expence would be sufficient to support them; and numberless citizens, which constitute the riches of a state, would, by this simple and natural mode of treatment, be saved to the public.

Children begin the difficult task of learning to speak about the 12th or 15th month. They pronounce the vowel A with most facility, because it requires only the opening of the mouth, and forcing out the air. E requires the tongue to be raised, at the same time that the lips are opened. In pronouncing I, the tongue is still more elevated, and approaches the teeth of the upper jaw. O requires the tongue to be depressed, and the lips contracted; and, in the pronunciation of U, the lips must be still more contracted, and somewhat extended. The first consonants articulated by children are those which require the least motion of the organs. B, M, and P, are most easily pronounced. B and P require only the lips to be joined, and then opened with celerity; and for M, they must be first opened, and then quickly shut. The articulation of the other consonants cannot be effected without more complicated movements. The pronunciation of C, D, G, L, N, Q, R, S, and T, depends upon particular motions of the tongue, which are not easily described. F requires a prolongation of sound beyond any of the other consonants. Thus, of the vowels, A is most easily pronounced; and, of the consonants, B, P, and M. It is for this reason that children, in all countries, first begin to articulate the words Baba, Papa, Mama. These words are the most natural, only because they are most easily pronounced; and the letters of which they are composed must exist in every language.

It is worthy of remark, however, that, as the sounds of several consonants are very similar, as those of B and P, of C and S, of K and Q, of D and T, of F and V, of G and J, of G and K, and of L and R, there may be many languages in which these different consonants are not employed. But, in every language, a B or a P, a C or an S, a K or a Q, a D or a T, an F or a V, a G or a J,

an L or an R, are indispensible; and, in the most contracted alphabets, there must be at least six or seven consonants: because the articulation of them is not complicated, and the sounds by which they are uttered are all distinct and different from each other. Children who cannot easily pronounce, substitute L in place of R, and D in place of T; because the former are less difficult to articulate than the latter: and the softness or harshness of a language depends on the choice of consonants which are more or less difficult to pronounce. But it is needless to enlarge upon this subject.

Some children, at two years of age, articulate distinctly, and repeat whatever is said to them; but most children require a long time. It has been remarked, that those who are long before they learn to speak, never articulate with the same facility as those who acquire that faculty more early. The latter may be taught to read before they are three years of age; and I have known children read amazingly at four. But, after all, it is difficult to determine whether any advantages are to be derived from such premature instruction. We have had so many examples of prodigies of learning at four, at eight, at twelve, and at sixteen years, who turned out to be either fools, or men of very little ability, at twenty-five, that I am inclined to think, that the common mode of education, by which nature is not prematurely forced, and which is discreetly proportioned to the strength and capacity of the children, is still the best.

SECTION III.

Of Puberty.

PUBERTY commences where childhood ends, and accompanies us through the after periods of life. Before puberty, nature seems to have had nothing in view but the growth and preservation of her work. The provision she has made for the infant extends no farther than the nourishment and expansion of its members. It lives, or rather enjoys a kind of vegetable existence, which is confined to itself, and which it cannot communicate. But the principles of life soon multiply: we are soon possessed of a stock, sufficient not only for our own being, but for enabling us to bestow existence upon others. This redundancy of life, the source of health and vigour, can no longer be confined, but is strongly impelled to expand and diffuse itself. The age of puberty is accompanied with several external and internal marks. It is the spring of life; the season of pleasure. May we be enabled to write the history of this critical period, without exciting any ideas but what are strictly philosophical! In the history of man, puberty, circumcision, castration, virginity, impotence, and many other circumstances, are articles too essential to be omitted. We shall, therefore, endeavour to describe them with that delicacy of style, that philosophical apathy, which annihilate every loose desire, and bestow on words nothing more than their simple and primitive signification.

Circumcision is a custom of great antiquity, and is still practised over the greatest part of Asia. Among the Hebrews, the operation was performed eight days after birth. In Turkey it is delayed to the seventh or eighth year, and sometimes to the eleventh or twelfth. The children in Persia are circumcised at the age of five or six; the wound is healed with caustic or astringent powders; and burnt paper is very generally used, which according to Chardin is the best remedy. This author tells, that the operation, when performed on grown persons, is attended with considerable pain: that they are obliged to be confined to the house three or four weeks; and that death is sometimes the consequence.

In the Maldivia islands, children are circumcised at the age of seven years. To render the skin soft, the children are bathed in the sea six or seven hours before the operation. The Israelites made use of a sharp stone; the Jews observe the same mode in most of their synagogues. But the Mohammedans employ a knife or a razor.

An operation similar to circumcision is necessary in certain diseases. It is a common opinion, that the prepuces of the Turks, and of other nations where circumcision is practised, would naturally grow too long, if they mere not curtailed in childhood. Boulaye says, that he has seen, in the deserts of Arabia and Mesopotamia, on the banks of the Tigris and Euphrates, numbers of Arabian boys whose prepuces were so long as to render them incapable of generation, without the aid of circumcision.

The people of the east have likewise longer eye-lids than the inhabitants of other nations. The skin of the eye-lids resembles that of the prepuce. But what rela-

tion can take place between the growth of those distant parts?

Girls as well as boys are circumcised, upon the borders of the Persic Gulf and the Red Sea. But these people never perform the operation till the girls have passed the age of puberty; because there is no redundance before that period. In other climates, the excess of growth in the nymphæ appears more early; and is so general among certain people, as those upon the river Benin, that they circumcise both girls and boys eight or ten days after birth. The circumcision of females was an ancient custom, even in Africa. Herodotus mentions it among the usages of the Æthiopians.

Circumcision may, therefore, be founded on necessity; it has, at least, propriety for its object. But castration must have arisen from jealousy alone. This ridiculous and cruel operation has been invented by gloomy and fanatical tyrants, who, actuated by a mean envy, and a desire of monopolizing natural pleasures, enacted and enforced those barbarous and bloody laws, which make privation a virtue, and mutilation meritorious.

Boys are infibulated by drawing the prepuce forward, piercing it, and putting a small cord through the holes, which remains till the cicatrice of the opposite sides be formed: the cord is then removed, and a ring substituted in its place, which is made of sufficient strength to last as long as the person who ordered the operation pleases; and sometimes it remains for life. The eastern monks, who take on the vow of chastity, employ a large ring, which renders the breach of their oath impossible. We shall afterwards mention the method of infibulating females. It is impossible to imagine any thing too ridiculous upon this subject, which has not been practised by some men, either from motives of passion or superstition.

During infancy, there is sometimes but one testicle in the scrotum, and sometimes none. We must not, however, conclude that children in this situation are totally destitute of these parts. It often happens, that the testicles remain in the abdomen or entangled in the rings of the muscles. But time generally removes these obstacles; and the testes descend into their proper receptacle at the age of eight or ten, and sometimes not till the season of puberty. Parents, therefore, have no reason to be anxious about such of their children as seemingly have no testes, or but one. The testicles of adults are seldom concealed; because nature, at the age of puberty, makes strong efforts to bring them to light. The same effect is sometimes produced by disease, or violent motion, such as a leap, a fall, &c. Even when the testicles never make their appearance, the purposes of generation are not frustrated. Men of this kind are often endowed with uncommon vigour.

There are men who have but one testicle. This defect, however, is inoffensive; for it is always uncommonly large. Some men have three, and are, on that account, said to possess more vigour and bodily strength. We learn, from the animal creation, how greatly these parts contribute to strength and courage. How different is an ox from a bull, a wedder from a ram, and a capon from a cock!

The practice of castration among mankind is very extensive and of great antiquity. It was the punishment of adultery among the Ægyptians. In the Roman dominions, the number of eunuchs was considerable: at this day, these mutilated males are employed through all Asia and part of Africa, as guards upon the chastity of the ladies. In Italy, this infamous, this cruel operation, has nothing for its object but the improvement of the voice. The Hottentots cut off one testicle, because they imagine that this operation renders them more swift in the chace. In other countries, the poor people mutilate their children, to make them incapable of procreation, and to prevent them from feeling those excruciating pangs which they themselves suffer, when they want bread to support their offspring.

The species of castration vary according to the object in view. When the improvement of the voice is intended, the two testicles are only cut out. But men, whose minds are inflamed with jealousy, would not believe their females to be safe in the custody of such eunuchs: they employ none but such as have been deprived of the whole external parts of generation.

But amputation is not the only means of accomplishing this end. Formerly, the growth of the testicles was prevented, and their structure destroyed, without any incision: they bathed the infants in warm water and decoctions of plants, and then pressed and rubbed the testicles for a long time, in order to destroy their texture. Others compressed them with an instrument: some pretend that this species of castration does not endanger life.

The amputation of the testicles is not very dangerous: it may be done at any age; the time of infancy, however, is always preferable. But the amputation of the whole external parts of generation is often fatal, especially if performed after the age of fifteen years. Even in the most favourable time, which is from seven to ten years of age, there is always great danger. The difficulty of preserving eunuchs of this kind renders them exceedingly precious. Tavernier informs us, that, in Turkey and Persia, they bring five or six times the price of the other kind. Chardin observes, that the total amputation is accompanied with the most exquisite pain; that it is performed pretty safely upon young children; and it is exceedingly dangerous after the age of fifteen; that hardly a fourth part escape with life; and that the wound is never cured in less than six

weeks. On the other hand, Pietro della Valle asserts, that those who suffer this punishment in Persia for rapes, and other crimes of that nature, heal easily, though advanced in years; and that they apply nothing but ashes to the wound. I know not whether those who underwent the same punishment in Egypt, as Diodorus Siculus relates, escaped with equal ease. According to Thevenot, vast numbers of negroes, who are forced by the Turks to submit to this operation, perish, even when it is performed on children of eight or ten years of age.

Beside negro eunuchs, there are others at Constantinople, throughout all Turkey, Persia, &c. who, for the most part, are brought from the kingdom of Golconda, the peninsula on this side the Ganges, the kingdoms of Assan, Aracan, Pegu, and Malabar, where their colour is gray; and from the Gulf of Bengal, where they are of an olive colour: there are some white eunuchs from Georgia and Circassia; but their number is small. Tavernier says, that, when he was in the kingdom of Golconda, in the year 1657, 22,000 males were castrated. The black eunuchs come from Africa, and especially from Æthiopia. In proportion to the ugliness and horror of their appearance, they are the more esteemed, and bring a higher price. A very flat nose, a frightful aspect, large thick lips, and, above all, black teeth placed at a great distance from each other, are admired qualities in a eunuch. These people have commonly fine white teeth: but such teeth would be a capital defect in a eunuch, who ought to be a hideous monster.

Eunuchs, who are only deprived of their testicles, have a lively sense of titulation in what remains: they have even the external sign more frequently than other men. The part which remains, however, is generally small; for it continues nearly in the same state in which it was before the operation. A eunuch castrated at seven years of age, when arrived at 20, is no better, with regard to this matter, than a child of seven. Those, on the other hand, who have not undergone the operation till the age of puberty, or later, have parts nearly equal to those of sound men.

Peculiar relations subsist between the throat and the parts of generation, though we are totally ignorant of their causes. Eunuchs have no beard; their voice, though strong and piercing, can never reach a low or deep tone. Secret diseases often appear in the throat. The remarkable sympathy which some parts of the body have with others, though at a distance, and of a different nature, is a subject too much neglected: we are apt to despise effects, when we cannot easily discover their causes. Hence it is, that we never think of examining these relations or sympathies, although they are the proper spring of the animal constitution. In females, there is a remarkable sympathy between the uterus, breasts, and head. How many curious and useful facts of this nature might be discovered, if physicians paid more attention to this interesting subject! It would produce more enlightened views, and a more extensive utility, than can ever be expected from a mere register of anatomical names. It is impossible to discover the principles of animal motion: the springs which give life to organization are not to be found in the muscles, veins, arteries, and nerves, described with such minuteness by anatomists. Organized bodies are possessed of internal powers, upon which the gross laws of mechanism have no influence. Instead of attempting to discover these powers, by attending to their effects, they have been treated as ideal existences; they have ceased to be the objects of philosophical research. They have at last reassumed their native importance in the laws of gravitation, in elective attractions, in the phænomena of electricity, &c. But, notwithstanding the evidence and universality of their existence, as their action is internal, as they are solely objects of reason, and have little connection with the senses, they are in danger of escaping our observation, and we admit them with difficulty; for judgment is generally occupied and directed by external objects. We never imagine that the internal constitution of animated beings ought to be a principal object of inquiry. We conceive that the human genius is limited to external objects; and, therefore, we overlook every thing that might lead to a more refined and spiritual philosophy.

The ancients, less limited in genius, and possessed of a more comprehensive philosophy, were not astonished to meet with facts which were inexplicable: they viewed Nature through a more transparent medium. A peculiar correspondence or sympathy, was to them only a phænomenon; but, to us, because not reducible to some fanciful laws of motion, it is a paradox. They knew that Nature produced her principal effects by laws concealed from human eyes: they knew, that, to trace her various laws and modes of operation, exceeded the powers of our circumscribed faculties. A certain number of uniform and related effects, therefore, was to them sufficient to constitute a cause, or law of nature. Whether, according to the ancients, this sympathy shall be called a peculiar correspondence between different parts of the body, or, according to the moderns, it shall be considered as an unknown relation in the action of nerves, its existence in the animal œconomy is universal; its effects, therefore, are of the utmost importance to the theory of medicine, and cannot be too diligently scrutinized. But this is not the place for a full investigation of such an important subject. I shall only observe, that the relation between the voice and the generative organs takes place not only in eunuchs, but in other men: it is even discoverable in females. In men, the voice changes at the age of puberty; and in women, who have a strong rough voice, the passion of love is suspected to be violent.

The first symptom of puberty is a sense of fulness and stiffness in the groins, which is most perceptible when walking, or when the body is bent forward. This stiffness is often accompanied with pretty smart pain in the different joints of the limbs: it is likewise accompanied with a new and peculiar sensation in those parts which distinguish the sexes. Small whitish tubercles also begin to appear in these parts, which are the germs of their natural veil. The voice, for a considerable time, is rough and unequal; after which it becomes more full, articulate, and strong. This change is very conspicuous in boys; but it is less distinguishable in girls, because their voices are naturally more sharp.

These marks of puberty are common to both sexes: but each sex has marks peculiar to itself; as the eruption of the menses, and the expansion of the breasts in women; the beard and faculty of procreating in men. These marks, indeed, are not always uniform. The beard, for example, does not always appear precisely at the age of puberty: there are even whole nations who have hardly any beard. On the contrary, there is no country where the age of puberty in women is not distinguished by the enlargement of the breasts.

Among every race of mankind, the females arrive at puberty sooner than the males. But the age of puberty is very different in different countries. It seems to depend upon the temperature of the climate and the quality of the food. The children of citizens and of opulent parents, who are generally fed with rich and nourishing victuals, arrive sooner at this state. But children brought up in the country, or whose parents are poor, require two or three years longer; because their food is not only bad, but given too sparingly. In the southern parts of Europe, and in cities, girls arrive at puberty about the age of 12, and boys about 14. But, in northern climates, and in the country, girls hardly come to maturity till they are 14, and boys not before 16.

It may be asked, Why are the females, in all climates, capable of procreating sooner than the males? the answer is easy: the bodies of men are larger and stronger; their bones are harder, and their muscles more compact; a longer time is therefore necessary for their growth. Besides, as the growth of the body must be nearly complete before a superfluous quantity of organic juices can be accumulated in the parts destined for generation, women, of course, must arrive at maturity sooner than men.

In the warmest climates of Asia, Africa, and America, the age of puberty commences in girls at ten, and sometimes at nine. The periodic discharge, though less abundant in warm climates, appears much sooner. The interval is nearly the same in all nations. With regard to time, a greater diversity takes place between individuals than between nations. In the same climate and nation, some females suffer this evacuation every 15 days; others have an interval of six weeks: but a month, or a few days more or less, is the most usual period.

The quantity evacuated seems to depend upon the quantity of nourishment and of insensible perspiration. The discharge is greatest in females who eat largely and take little exercise: it is least in warm countries, where the perspiration is more copious. The quantity of this discharge has been variously estimated. It is, indeed, difficult to make an accurate measure. In different subjects, and different circumstances, it varies from one or two ounces to a pound, and even more. It generally continues to flow three, four, or five days; but sometimes it remains for six, seven, and even eight days. The cause of this discharge is generally ascribed to a superfluity of bloody and nutritious juices. The symptoms which precede it are certain indications of a plethora, as heat, tension, swelling, and the pains felt not only in the parts themselves, and their environs, but in the mammæ, which also swell, and discover a superabundance of blood by the colour of the areolæ becoming then more deep: the eyes likewise are heavy, and the skin below the orbits takes on a faint blue or a violet colour: the cheeks glow; the head is heavy and affected with pain; and, in a word, the whole body is oppressed with a surcharge of blood.

The growth of the body, in length, generally terminates at the age of puberty. Before this period, young people commonly shoot up several inches in a very short time. But the quickness of growth is most remarkable in the parts of generation of both sexes. In males, this growth, is only an augmentation in size: but, in females, it often produces a shrinking of some of the parts, which has received different appellations from those who have treated of the signs of virginity.

Men, jealous of pre-eminence of every kind, have always discovered a remarkable attachment to prior and exclusive possessions. This species of folly has bestowed a physical existence upon female virginity. Virginity, which is a moral being, a virtue existing solely in purity of heart, has been metamorphosed into a physical object, in which most men think themselves deeply interested. This notion, accordingly, has given rise to many absurd opinions, customs, ceremonies, and superstitions; it has even given authority to pains and punishments, to the most illicit abuses, and to practices which shock humanity. Young women have been obliged to submit to the examinations of ignorant matrons, and to expose the secrets of nature to the eyes of prejudiced physicians. They did not reflect, that every indecency of this kind is a violent attack against chastity; that every situation which produces an internal blush, is a real prostitution.

I have little hope of being able to eradicate the ridiculous prejudices which have been formed on this subject.

Mankind always believe what they wish to be true, however vain and unreasonable the foundations of their faith. But, as it is the province of history to relate not only the succession of events, and the circumstances of facts, but likewise the origin of popular opinions and errors, I think it a necessary article in the history of man to examine this favourite idol which he adores, to consider the reasonableness of his worship, and to inquire whether virginity be a real or a fabulous divinity.

Fallopius, Vesalius, Diemerbrock, Riolan, Bartholin, Heister, Ruysch, and some other anatomists, maintain, that the membrane of the hymen has a real existence, and that it ought to be reckoned among the parts of generation peculiar to females. They assert, that it is a fleshy membrane, very thin in infants, but thicker in adults; that it is situated under the orifice of the urethra, and nearly shuts up the entrance of the vagina; that it is perforated by a round or oval hole, so small as hardly to admit a pea during infancy, or a large bean at the age of puberty. The hymen, according to Winslow, is a membranous fold, sometimes circular, and sometimes semilunar, with an aperture of a smaller or greater size in different subjects, &c. On the other hand, Ambrose Paré, Dulaurent, De Graaff, Pineus, Dionis, Mauriceau, Palfyn, and other anatomists of equal authority with those formerly mentioned, insist, that the membrane of the hymen is a mere chimera; that it is not natural to young girls; and express their astonishment that any man should talk of it as a thing which has a real and uniform existence. They produce a multitude of experiments and observations made upon subjects of different ages, in which they could never discover any appearance of this membrane. They acknowledge, that they have sometimes, but very seldom, seen those fleshy protuberances called carunculæ myrtiformes connected by a membrane; but they maintain that this membrane was preternatural. Anatomists are not less divided with regard to the number and qualities of these carunculæ. Are they only rugosities of the vagina? Are they distinct and separate parts? Are they the remains of the hymen? Is their number uniform? Does only one, or many, accompany the state of virginity? All these questions have been stated, and each has received a different solution.

This opposition of sentiment, in a matter which depends on inspection, is an incontestible proof, that mankind have often an ardent desire to discover things in nature which exist in their own imaginations only. Many anatomists of reputation have never been able to discover either the hymen or carunculæ, even before the age of puberty. Those who support the contrary opinion, at the same time acknowledge, that these parts are not always the same; that their form, size, and texture, vary in different subjects; that, in place of the hymen, sometimes there is but one caruncula, at other times there are two or more united by a membrane; that the shape of the aperture is not uniform, &c. What is the consequence? We must conclude, that the causes of this mark of virginity are equivocal and inconstant; and that, even when they have existence, they produce only an effect of a transient and variable nature. Anatomy determines nothing with regard to the existence of the hymen and carunculæ; it allows us to reject these symptoms of virginity, because they are not only uncertain, but imaginary.

The effusion of blood, though a more common symptom, is not less equivocal. It has, in all ages, been regarded as an infallible proof of virginity. But it amounts to nothing, in all those cases where the entrance of the vagina is naturally relaxed or dilated. Besides, the effusion of blood is not peculiar to virgins. Women who have no pretensions to virginity frequently experience this discharge. Some discharge copiously and often; others a small quantity, and only once; and some have no such effusion. This phænomenon depends upon age, health, structure of parts, and a number of circumstances. Of these we shall enumerate only a few, and endeavour, at the same time, to investigate the true causes of the various physical marks which have been held forth as infallible characteristics of female virginity.

At the time of puberty, the parts of both sexes undergo a considerable change: those of the male have then a growth so quick, that they arrive in a year or two at full maturity. Those of women increase likewise at this period. The nymphæ, in particular, which, though formerly almost imperceptible, now become full and conspicuous. The menstrual discharge appears at the same period. By an unusual accumulation of blood, all the parts swell, and approach towards each other. The orifice of the vagina contracts, though the dimensions of the vagina itself be enlarged. The appearances produced by this contraction are different in different subjects; for we are informed by anatomists, that there are sometimes four, and sometimes only three, or two carunculæ; and that a circular or semilunar ring, or rather a series of folds, is a common phænomenon. But anatomists have neglected to tell us, that, whatever form this contraction assumes, it never appears before the age of puberty. In young girls whom I have had occasion to dissect, nothing of this kind could be discerned; and, having collected many facts concerning this subject, I can with confidence assert, that when young women, before puberty, have commerce with men, no effusion of blood ever happens, unless the parts be greatly disproportioned, or some violence is committed. On the other hand, at the time of puberty, especially when the females are regular, and in good health, these effusions are common, and produced by the slightest causes. But those who are meagre, and subject to the fluor albus,

generally want this mark of virginity. The frequent repetition of this flux of blood, and even at considerable intervals of time, is an evident demonstration that it is only a deceitful appearance. It is a certain fact, that young women, who at first had a copious effusion, have repeated this pretended symptom of virginity after a few months abstinence. This phænomenon may, by proper management, be frequently exhibited, especially before the body has acquired its full growth. It is equally certain, that young women, who have not been faithful to the marriage-bed, have, notwithstanding, by the simple expedient of abstinence, given fresh proofs of innocence to their deluded husbands. Some women, in the course of two or three years, have exhibited this fictitious mark of purity five times. But this symptom is limited to a certain time; for it seldom appears after the age of eighteen years. When the growth of the body is compleated, its parts become fixed and unalterable, and cannot assume differences but by the employment of such artifices as it would be both unnecessary and improper to relate. Besides, many women, particularly who are irregular in their menses, and subject to the fluor albus, never have any fresh marks of virginity.

Nothing, therefore, can be more chimerical than the prejudices of men with regard to virginity, and nothing can be more fallacious than its pretended signs. A young woman may have commerce with a man before the age of puberty, and yet exhibit no marks of virginity. But the same woman, after she arrives at puberty, may have very copious effusions of blood. Others, who are actual virgins, discover no such appearances. Men, therefore, should be perfectly easy as to this matter, and not indulge, as is too often the case, unjust and ridiculous suspicions.

If we wish to obtain an evident and infallible mark of virginity, we must search for it among those barbarous people, who are incapable of instilling by education the sentiments of virtue and honour into their children, but secure the chastity of their daughters by an expedient which could only be suggested by the rudeness of their manners. In Æthiopia, and other parts of Africa, in Pegu, Arabia Petrea, and other nations of Asia, the inhabitants, immediately after the birth of females, sew up those parts which nature has separated, leaving only a space sufficient for the natural evacuations. As the child grows, the parts gradually adhere, and, when the time of marriage arrives, they are again disunited by incision. Instead of thread, the fibres of the asbestos are said to be employed, which is a substance not liable to sudden corruption. Some tribes content themselves with putting a ring through the parts. To this operation wives as well as girls are subjected, with this difference, that the ring allotted to the latter cannot be removed, but, in that allotted to the former, there is a lock, of which the husband alone possesses the key. But why should we mention barbarous nations, when we have similar examples at no great distance? That absurd delicacy of a neighbouring nation, with regard to the chastity of their wives, is the offspring of a brutal and criminal jealousy.

How opposite are the tastes, the dispositions, the opinions, and the manners of different nations? After what has been related concerning the high estimation of virginity among the bulk of mankind, and the numberless precautions and ignominious methods employed to secure it, is it possible to believe that there are other people who despise virginity, and consider the trouble of removing it to be a mean and servile office?

Superstition has induced the inhabitants of certain countries to resign the first fruits of virginity to their idolatrous priests, and sometimes to the idols themselves. This privilege is enjoyed by the priests of Cochin and of Calicut; and, in Goa, the virgins are prostituted by their parents, either voluntarily or from choice, to an idol of iron. Gross superstition induces these people to commit such abominable outrages from religious motives. But views more servile and interested have induced men of other countries to devote their daughters to their chiefs. The inhabitants of the Canary isles, and of the kingdom of Congo, prostitute, in this manner, their daughters, without any injury to their reputation. Nearly the same custom takes place in Turkey, Persia, and several other countries both of Asia and Africa. Their most eminent nobles think themselves highly honoured to receive from their sovereign women with whom he himself is already disgusted.

In the kingdom of Aracan, and in the Philippine islands, a man would esteem it to be disgraceful to marry a young woman who had not been previously deflowered; and nothing but the force of money can prevail on any person to precede the husband. In the province of Thibet, mothers anxiously search for strangers, and earnestly solicit them to put their daughters in a proper state for obtaining husbands. The Laplanders likewise prefer girls who have had commerce with strangers. They fancy them to possess uncommon merit, because they have been able to please men who are better judges of beauty and female accomplishments than themselves. In Madagascar and several other countries, the most dissolute and debauched women are soonest married. Many other examples might be given of this strange taste, which nothing but the grossest and most depraved manners could produce.

After puberty, marriage is the natural state of man. A man ought to have but one wife, and a woman but one husband. This is the law of nature; for the number of females is nearly equal to that of males. Such laws as have been enacted in opposition to this natural principle, have originated solely from tyranny and ignorance. Reason, humanity, and justice revolt against

those odious seraglios, in which the liberty and the affections of many women are sacrificed to the brutal passion of a single man. Does this unnatural pre-eminence render these tyrants of the human race more happy? No! surrounded with eunuchs, and with women useless to themselves and to other men, they are tormented with the constant appearance of that accumulated load of misery they have created.

Marriage, therefore, as it is established among us, and other nations who are directed by the lights of reason and revelation, is a state most consonant to the nature of man, and in which it is his duty to employ those new faculties he acquires from puberty. By obstinately persisting in celibacy, these powers become troublesome, and sometimes fatal. In either sex, too long continency may give rise to diseases, or create irritations so violent, that neither reason nor religion may be able to counteract the impetuosity of those passions they excite: and thus man may be reduced to a level with the brutes, which, under the influence of such sensations, become perfectly furious and ungovernable.

In women, the furor uterinus is the most violent effect of this irritation. This disease is a species of madness, which deranges their ideas, and deprives them of all sense of shame. Both the nature and the seat of this melancholy distemper are indicated by the most lascivious expressions, and the most indelicate actions. I have seen, with astonishment, a girl at the age of twelve years, who had a brown, but lively and florid complexion, and, though low in stature, was strong and plump, commit the most indecent actions upon the very appearance of a man, from which she could not be deterred, either by the presence or chastisement of her mother. She did not, however, lose her reason; and the paroxysms of the disease ceased, the moment she was left with her own sex. Aristotle alledges, that, at this age, the irritation is strongest, and that girls ought then to be carefully watched. The remark may be applicable to the climate in which he lived; but, in colder countries, the ardour of the female constitution does not appear so early.

When the furor uterinus increases to a certain degree, marriage will not remove it; and there have been instances of its proving fatal. Happily the force of nature is seldom the only cause of a passion so detestable, even when there is a predisposition to it in the habit of body. Before it arrives at this extremity, the imagination must be inflamed by licentious conversation, by obscene representations, or other causes. Among women, the opposite temperament is infinitely more common; for, with regard to this passion, most of them are either cool or indifferent. There are also many men to whom chastity is an easy virtue. I have known some men who, at the age of twenty-five or thirty, enjoyed good health, without having ever felt this passion so strong as to render any gratification necessary.

Continency, however, is less to be dreaded than excess. The number of immoderate men is too great to require particular examples. By excess, some have lost their memory; some have been deprived of sight; some have become bald; and many have perished by pure debility. Young persons can never be sufficiently warned of the irreparable injury to their health, which the indulgence of the venereal appetite never fails to produce. How many cease to be men, or, at least, cease to enjoy the powers of manhood, before the age of thirty! and how many, at fifteen or eighteen, receive the seeds of a disease, disgraceful in itself, and which it is often impossible to eradicate!

It has already been remarked, that at the age of puberty, the growth usually stops. It frequently happens, however, that, even after puberty, a tedious illness makes the body increase in length more than it would have done in a state of perfect health. This extraordinary increase is probably occasioned by the inactivity of the external organs of generation during the course of the disease. The organic particles do not reach these parts, because they are not determined thither by irritation; and this defect of irritation is owing to a lassitude and imbecility of the parts, which prevent the secretion of the seminal fluid. These organic particles, therefore, remain in the mass of blood, and necessarily extend the extremities of the bones, nearly in the same manner as happens to eunuchs. Thus young people, after recovering from a long sickness, are often taller, but worse shaped, than formerly. Some, for instance, become hunch-backed, and others crook-legged; because the still ductile extremities of the bones have been unnecessarily extended by a superfluity of organic particles, which, in a state of health, would have been exhausted in the formation of seminal fluid.

The production of children is the chief intention of marriage. But this intention is sometimes frustrated. Of the different causes of sterility, some are common to both sexes. But, as these causes are more apparent in men than in women, they are, therefore, more commonly ascribed to the former. In both sexes, sterility is occasioned either by a defect in the original conformation, or by accidental injuries done to the organs themselves. In men, the most pernicious defects of conformation are those which affect the testicles, or the muscles called *erectores penis*. A wrong direction of the urethra, which is sometimes not only oblique, but improperly perforated, is another obstacle to generation. The adhesion of the prepuce to the frænum is another obstacle; but it is not insurmountable. In women, the conformation of the uterus may likewise occasion sterility. If the orifice of the uterus be always open, or always shut, conception will be equally prevented. But the most frequent cause of barrenness, both in men and women, arises from some depravity in their seminal fluids. I

formerly quoted a remark of Valisnieri, that a corruption of the fluid in the testicles of women rendered them entirely barren. It is the same with men. If the secretion by which semen is formed be vitiated, the fluid is unfit for impregnation. These causes of sterility are not discoverable by any external appearances.

In cases of sterility, different means have been employed to discover whether the defect proceeded from the man or the woman. Inspection is the first resource; and, if the barrenness be occasioned by a fault in the external conformation, it is sufficient. But, if the defect lie in the internal organs, it is hardly possible either to discover or remove it. Some men, though they appear to be perfectly formed, want the genuine sign of a proper conformation. Others have this sign so imperfectly, or so seldom, that it is only a very equivocal mark of virility.

Every body knows that the action of this part is not under the command of the mind. It is the most animal part of the human body; for it acts by a kind of instinct, the causes of which are unknown. How many young persons, educated in perfect purity, and totally ignorant of pleasure, have felt the most lively impressions, without being able to recognize either their cause or their object! how many, on the contrary, remain cold and languid, notwithstanding all the efforts of sense and imagination!

This part of our bodies, therefore, belongs less to us than any other of our members. It acts or is languid without our participation. Its functions commence or terminate at certain periods. All this happens without our command, and often contrary to our inclination.

When there is no defect in the external conformation, barrenness proceeds oftener from the woman than the man; for, independent of the pernicious effects of the fluor albus, there seems to be another cause which has never excited attention.

From my experiments, it appears that the testicles of females give birth to a kind of natural protuberances, which I have called *glandulous bodies*. They grow in a gradual manner, and serve for secreting and maturating the seminal fluid. They are in a continual fluctuating state. They begin to grow under the membrane of the testicle, which they soon perforate; they then swell, and their extremities spontaneously open, and distil a seminal fluid for some time; after which they gradually decay, leaving only a small reddish cicatrice on the place from whence they sprung. These glandulous bodies no sooner disappear than they are replaced by others; so that the testicles are continually labouring, and undergoing considerable changes. Hence any derangement in these organs, either by an unusual thickness of the fluid, or weakness of the vessels, prevents the proper exercise of their functions, renders them unable to secrete, or rather vitiates and corrupts the seminal fluid, which necessarily gives rise to sterility.

Conception sometimes precedes puberty. Many women have become mothers before the appearance of the menses; and some who never had any symptoms of this evacuation, are in the habit of bearing children. Instances of this kind happen in our climate, without travelling for them to Brazil, where whole nations are said to be perpetuated, though not a single woman be subject to the menstrual discharge; an evident proof that it is not the menstrual blood, but the seminal fluid of the male and female, which are essentially necessary to generation. It is likewise known, that the cessation of the menses, which generally happens about the age of forty or fifty years, does not disqualify every woman for conception; for some women have become pregnant at sixty or seventy, and even at an age still more advanced. These examples, though pretty frequent, may be regarded as exceptions to the general rule; but they are sufficient to demonstrate that the menstrual blood is by no means essential to generation.

In the ordinary course of Nature, women conceive not before the menses appear, nor after they have ceased. The age at which men first acquire the faculty of generating is not so distinctly marked. His body must attain a certain growth before semen is secreted; and, before this fluid be fully maturated, the degree of growth must be still greater. This generally happens between the twelfth and eighteen years. But the period when man loses the generative faculty, Nature seems to have left undetermined. At sixty or seventy when old age begins to enervate the body, the semen is less abundant, and often unprolific. In the collections of public societies, however, there are many instances of men who have continued to procreate at the age of eighty and ninety.

There are likewise examples of boys who have procreated at eight, nine, and ten years, and of girls who have conceived at seven, eight, and nine years. But such facts are exceedingly rare, and ought to be regarded as singular phænomena. The sign of virility appears in infancy: but that is not sufficient; the production of semen must be added; and this happens not till the growth of the body is nearly completed. At first the quantity is small and generally sterile.

Two marks of conception have been mentioned by authors. The first is a kind of tremor, or shivering, which is said to begin at the moment of conception, and continues for some days. The second is derived from the orifice of the uterus, which, it is asserted, closes entirely after conception. But these signs appear to be very equivocal, if not altogether imaginary.

This tremor is mentioned by Hippocrates in the following terms: ‘Liquido constat harum rerum peritis, ‘quod mulier, ubi concepit, statim inhorrescit ac den-

'tibus stridet, et auriculam reliquumque corpus convulsio 'prehendit.' Galen, on the authority of some women, imputes this symptom to the contraction of the uterus. Others express it by a vague sensation of cold over the whole body, and employ the words *horror* and *horripilatio*. These, and other authors, endeavour, like Galen, to establish the fact upon the testimony of women. Hippocrates says, 'quæ in utero gerunt, harum os uteri 'clausum est;' or, according to another translator, 'quæcunque sunt gravidæ, illis os uteri connivet.' Opinions, however, are various as to the changes which the uterus undergoes after conception. Some maintain, that the edges of the *os tincæ* are drawn so close together, that no vacuity is left between them; and others affirm, that these edges are not exactly close till after the two first months of pregnancy. They agree, however, that, immediately after conception, the orifice is shut up by a glutinous humour; that the os tincæ, which, previous to conception, might admit a substance of the size of a pea, has no perceptible aperture; and that this difference is so evident, as to be distinguishable by a skilful midwife. If these assertions were founded in truth, the state of pregnancy might be known a few days after conception.

It is urged, on the other hand, if, after conception, the orifice of the uterus were closed, superfœtation would be impossible. To this it may be replied, that the seminal liquor may perhaps penetrate through the membranes of the uterus; that the uterus itself may open to receive the materials necessary for superfœtation; and that, at any rate, superfœtations so seldom happen, that they make a very trifling exception to the general rule. Other authors maintain, that this change in the uterus can never appear but in women who have formerly conceived and brought forth children. In first conceptions, indeed, the difference must be less perceptible; but, though ever so conspicuous, we have not sufficient evidence to conclude, that it is a certain, a uniform, and a positive sign. The study of anatomy, aided by experience, affords, on this subject, general notions only, which vanish upon a closer examination. The same observation may be applied to the shivering, or convulsive cold, which some women are said to feel at the time of conception. As most women experience not this sensation; as others, on the contrary, assure us, that they have felt a burning heat; and as others still confess that they are utter strangers to all such feelings; the natural conclusion is, that all these marks are highly equivocal, and that, when they do happen, they ought to be considered, not as the effects of conception, but of other causes.

On this subject I shall add one fact from Mr. Parsons's lectures on muscular motion, which proves, that the orifice of the uterus does not close immediately after conception, or, if it does close, that the semen may find a passage into the uterus by penetrating its substance. In the year 1714, a woman of Charlestown, in South Carolina, was delivered of two children, the one immediately after the other. To the astonishment of the assistants, the one child was black and the other white. This evident testimony of the woman's infidelity to her husband, obliged her to acknowledge, that, one morning, her husband having just left her bed, a negro entered her chamber, and, by threats of immediate death, compelled her to gratify his desires. This fact shows, that the conception of two or more children does not always happen at one time, and supports my opinion, that the semen penetrates through the texture of the uterus.

There are many other equivocal signs of pregnancy, by which it is said to be early distinguishable; as a slight pain in the region of the uterus and loins; a numbness over the whole body; a continual drowsiness; a melancholy and capricious disposition; the toothach; headach; and a vertigo, which obscures the sight; yellowish, blood-shot eyes, with contracted pupils and depressed eye-lids; a pale and spotted countenance; a depraved appetite, accompanied with vomiting and spitting; hysteric symptoms; the fluor albus; the stoppage of the menstrual discharge, or, instead of it, an hæmorrhage; the secretion of milk in the breasts, &c. Many other marks, supposed to be peculiar to pregnancy, might be added; but they are frequently nothing more than the effects of particular diseases. But we shall leave the discussion of these to physicians. Details of this kind, to be useful, would require a long series of profound investigation. This subject, like many others in physiology, in the animal œconomy, and in different branches of the medical art, has seldom been treated with any degree of philosophical accuracy.

SECTION IV.

Of Manhood.

At the age of puberty, or a few years after it, the human body attains its full stature. The growth of some persons stops at the fourteenth or fifteenth year; and, in others, it continues till they arrive at twenty-two or twenty-three years. During this period, most men are of a slender make: their thighs and legs are small, and the muscular parts are not properly filled up. But, by degrees, the muscles swell, the limbs and different parts of the body assume their proper figure and proportions, and, before the age of thirty, the body, in men, acquires its most perfect symmetry.

But, in women, the body sooner attains this symmetry. As their size is smaller, and their muscles, and other parts, less strong, compact, and solid, than those of men, they arrive more early at a state of maturity. A woman at twenty years is as perfectly formed as a man at thirty.

The body of a well shaped man ought to be square, the muscles boldly marked, and the features of the face distinctly defined. In women, the parts are rounder and softer, and their features are more delicate. Man is adorned with strength and majesty; grace and softness are the peculiar embellishments of woman.

Even the external figure of the human species declares them to be the sovereigns of the earth. The body of man is erect; his attitude is that of command; and his countenance, which is turned towards the heavens, is impressed with the signatures of superior dignity. The image of his soul is painted in his face; the excellence of his nature penetrates through his material form, and animates his features with a divine illumination. His majestic deportment, and the firmness of his movements, announce the superiority of his rank. He touches the earth with his extremity only: he views it at a distance, and seems to despise it. His arms are not pillars to support his body: his hands tread not the earth, and lose not, by friction and pressure, that delicacy of feeling for which they were originally destined. His arms and hands are formed for purposes more noble, namely, for executing the commands of his intellect, for laying hold of distant objects, for removing obstacles, for defending him from injuries, and for seizing and retaining objects at pleasure.

When the mind is at ease, all the features of the countenance are in a state of profound tranquillity. Their proportion, their harmony, their union, point out serenity of sentiment, and accord with the calm that subsists within. When the soul, however, is agitated, the human visage becomes a living canvas, upon which passions are represented with equal energy and delicacy; where every emotion is expressed by a correspondent feature; where every impression anticipates the will, and reveals, by obvious and pathetic characters, those intentions and feelings which we are solicitous to conceal.

It is in the eyes that the passions are most strongly marked, and most readily discovered. The eye belongs to the soul more than any other bodily organ. It participates of every mental emotion, the softest and most tender, as well as the most violent and tumultuous. It exhibits these emotions in all their force and purity, and infuses into the soul of the spectator the fire and the agitation of that mind in which they originate. In fine, the eye reflects the light of thought, and the glow of sentiment; it is the sense of the understanding, and the language of intelligence.

Men who squint, or are short-sighted, have less of this external soul, (as it may be termed), whose chief residence is in the eye. These defects hurt the physiognomy, and give to the finest countenance a disagreeable, and often a stupid air. As nothing but strong and violent passions are discoverable in visages of this kind, and, as they exhibit no marks of delicacy or vivacity of sentiment, we are apt to form unfavourable impressions of such persons, which, however ill founded, it is difficult for us to efface. We are so accustomed to be influenced by external appearances, that, if no symptoms of thought and reflection appear in a man's countenance, we instantly decide him to be void of ability. We even draw conclusions from the cut of the clothes, or the curls of the periwig; neither are these conclusions always false. Men ought, therefore, to pay some attention to these minute articles; because, in the eye of strangers, they make a part of ourselves, and contribute not a little to the judgments they form of our understanding and breeding.

A vivacious or a languid motion of the eye has a prodigious effect on the character of the countenance. Eyes are of different colours, dark hazel, light hazel, green, blue, gray, and whitish gray. The iris has a smooth,

velvet-like appearance, and consists of many small filaments, regularly disposed, and directed towards the centre of the pupil. The most usual colours of the eye are the hazel and the blue; and both these colours are sometimes to be found in the same eye. The eyes commonly called black, when narrowly inspected, are only of a dark hazel colour. They appear black in consequence of their being contrasted with the white of the eye. Those of a less deep hazel are likewise reckoned black, but are not equally beautiful. Shades of orange, hazel, gray, and blue, are frequently to be met with in the same eye; but, wherever there is a blue tint, it becomes the prevailing colour, and outshines all the rest. The black and the blue are the most beautiful colours, and give most fire and vivacity of expression to the eye. In black eyes there is more force and impetuosity; but the blue excel in sweetness and delicacy. The former dart forth a perpetual and uniform flame, because their colour appears always the same, and reflects the same rays: but the modifications of light are distinguishable in the blue; because different rays are reflected by the various tints of which they are composed.

These, and other varieties in the colours of the eyes, are peculiar to man, the horse, &c. In most other animals, the colours of individuals vary not. The eyes of the ox are brown; those of the sheep are of a watery colour; those of the goat are gray, &c. Aristotle alledges, that, among men, gray eyes are the strongest; that the blue are weaker; that prominent eyes are short-sighted, and that brown eyes see not so well as others in a faint light.

Though the eye, in moving, seems to be drawn towards either side, yet it only moves round its own centre, which gives the pupil the appearance of approaching or receding from the angles of the orbit, and of being elevated or depressed. In man the eyes are nearer each other than in any other animal. In some species, the eyes are so remotely situated, that it is impossible for both eyes to see the same object at the same time.

Next to the eyes, the parts which give most character to the countenance are the eye-brows. Being totally different from every other feature, their effect is augmented by the contrast: they form a deep shade in the canvas, and give relief to the other colours and features. The lashes of the eye-lid have also their effect; when long and bushy, they bestow beauty on the eye, and give a mild and pleasant aspect to the face. Lashes on both eye-lids are peculiar to man and the ape. Other animals have hair on the upper lid only; and, even in man, the lash of the under lid is less than that of the upper. The eye-brows have only two movements; one by which they are elevated; and the other by which they are depressed and contracted.

The eye-lids guard the ball of the eye from dust, insects, &c. and keep the cornea moist. The upper eye-lid moves up and down; but the under lid has little or no motion. Although the motion of the eye-lids be subject to the will, yet, by sleep, fatigue, or surprize, we lose the command of them. They are sometimes also affected with convulsive motions, which we are unable to restrain. In birds and amphibious quadrupeds, the under eye-lid alone moves; and fishes and insects have no eye-lids either above or below.

The forehead occupies a large part of the face, and contributes greatly to its beauty. It should be well proportioned, neither too flat nor too prominent; neither too narrow nor too short; and it should be regularly adorned with hair both above and on each side. The hair gives great expression to the countenance; baldness is therefore a capital defect; and the practice of employing superficial hair, which is now so general, ought to be confined to such as are naturally bald; for borrowed locks often change the true character of the face. If every man wore his own hair, and allowed it to float freely, it would be more easy to distinguish characters by the general aspect of the countenance. The crown of the head, and immediately above the temples, are the parts which first become bald; but the hair below the temples, and on the under part of the back of the head, seldom falls off. Baldness is peculiar to man: women, in the most advanced age, though their hair becomes white, are seldom affected with baldness: children and eunuchs are not more subject to it than women; and the hair is stronger and more abundant in youth than at any other period. The longest hair becomes dry, and gradually wastes and falls off as we advance in life. The whiteness commences at the points; and, when the hair is totally white, it loses its strength, and at last falls off altogether. There have been examples of young people whose hair was rendered white by disease, and which recovered its natural colour after their health was restored. It is alledged by Aristotle, that no man becomes bald before having intercourse with women, except such as have been bald from their birth. The ancient writers upbraid the inhabitants of the islands of the Archipelago with the epithet *bald-heads;* and assert, that these islanders are all brought into the world with this defect.

The nose is the most prominent feature in the face. But, as it has very little motion, even in the most violent passions, it contributes more to the beauty than to the expression of the countenance; and, unless it be deformed, or greatly disproportioned, it is less attended to than those features which are capable of motion, as the mouth and the eyes. The form of the nose, and its remarkable prominency, are peculiar to the human species. Most animals have nostrils separated by a partition; but none of them have an elevated and advanced nose. Even the apes may be said to have nostrils only; the nose of an ape has the same position as that of a man; but it is so short and flat, that it can hardly be regarded as

similar. By this organ, men, and most animals, breathe, and smell odoriferous bodies. Birds have no cartilaginous nostrils; they have only two holes or pipes for the purposes of respiration and smelling.

Next to the eyes, the mouth and lips have both the greatest motion and expression. These motions are excited by the passions, and the various forms of the mouth mark their different characters and modifications. The organs of speech give the mouth an animation superior to every other part of the face. The vermilion of the lips, and the whiteness of the teeth, so much excel the other colours of the face, that they attract our chief regard. We fix our eyes on the mouth of the speaker; every word, every articulation, produces different motions on the lips; and, however rapid, it is easy to distinguish them from each other. The deaf learn to distinguish these motions so accurately, that they often know the sentiments of the speaker merely by attending to the motions of his lips.

In man, and in all other animals, the under jaw is alone endowed with the power of motion. The crocodile, the opinion of Aristotle and many other naturalists notwithstanding, is not an exception: I have examined many skeletons of that animal, and have found, by the nature of the articulation, that the under jaw alone was moveable. In the human fœtus, and in monkeys, the under jaw is greatly advanced before the upper. The deformity, in adults, is equal, whether the under jaw be too prominent, or too much depressed: it ought to be nearly on a level with the upper. Strong passions, as well as languor, often produce an involuntary motion in the under jaw: pain and pleasure, as well as languor, give rise to yawning; but, in the former, the motion is more brisk and lively.

When the mind is suddenly affected with ardent desire, or keen regret, we feel a sort of starting, or internal oppression; this motion of the diaphragm elevates the lungs, and produces that sudden inspiration which forms a sigh: and, when the mind considers the cause of its emotion, and perceives no method of accomplishing its desire, or of banishing its regret, the sighs are repeated, and sorrow, or mental pain, succeeds. If this pain of mind be great and unexpected, it produces tears; the air rushes quickly into the lungs, and gives rise to many inspirations, which are accompanied with involuntary shocks: each inspiration makes a noise stronger than that of sighing, and is distinguished by the name of sobbing; these sobs succeed each other more rapidly than sighs; and, in the former, the sound of the voice is more apparent. The accent of the voice is still more distinguishable in groaning, which is a species of sob long continued; and its slow sound is heard both in expiration and inspiration: its expression consists in the continuation of a plaintive tone formed by inarticulate sounds. Groans are shorter or longer according to the degree of sorrow or dejection; but they are generally repeated several times. The time of inspiration forms the interval that takes place between each groan; and the intervals are nearly equal both in their duration and their distance. The plaintive shriek is a groan expressed with force, and with a high tone of voice. The shriek, when very sharp, generally continues on the same tone through its whole extent; but, when moderate, it commonly ends in a lower tone.

Laughter is an interrupted sound, often repeated, and accompanied with a kind of convulsive motion of the belly, which is alternately elevated and depressed. To facilitate this motion, the breast and head are sometimes thrown forward; the chest remains immoveable; the angles of the mouth recede from each other; and the cheeks swell: every time that the belly is depressed, the air bursts from the mouth, and occasions a noise, which, during the fit, is often repeated, sometimes on the same tone, and sometimes the tones gradually diminish.

The lips, in immoderate laughter, and in most violent passions, open wide; but, in the more tranquil emotions, the angles of the mouth recede, without any opening of the lips, the cheeks swell, and, in some persons, dimples are formed in them near the corners of the mouth: this charm belongs to the graces, and is commonly attended with an agreeable smile, which is a mark of benevolence, and of internal satisfaction: a smile is also a mode of expressing contempt and ridicule; but, in these malignant smiles, we press the lips close to each other.

The cheeks are uniform features, and have little motion or expression, except from that involuntary redness or paleness with which they are covered in different passions; they unite the features, and give a contour to the face; they contribute more to beauty than to expression; and the same observation may be applied to the chin, the ears, and the temples.

Shame, anger, pride, joy, equally give rise to blushing; while, fear, terror, and sorrow, produce a paleness in the face. This change of colour is involuntary; it exhibits the state of the mind without its consent. It is an effect of sentiment over which the will has no command. We can easily disguise the other marks of passion; for a moment's reflection enables us to stop the action of the muscles of the face which characterize particular passions, and even to change their direction; but to stop or alter the redness or paleness of the countenance, is beyond our power; because these depend on a peculiar motion of the blood, occasioned by the action of the diaphragm, which is the chief internal organ of sensation.

In different passions, the whole head is affected with different motions and positions: it hangs forward during shame, humility, and sorrow; it inclines to one side in languor and compassion; it is elevated in pride, erect

and fixed in obstinacy and self conceit; it is thrown backward in astonishment or surprise; and rolls from side to side in contempt, ridicule, and indignation.

Grief, joy, love, shame, and compassion, make the eyes swell, and cause the tears to flow. The effusion of tears is always accompanied with a contraction of the muscles of the face, which opens the mouth; the tears flow through the lachrymal ducts into the nose, and increase the fluid with which it is naturally moistened: the flowing of the tears is not constant; they seem to burst out at irregular intervals.

In grief, the corners of the mouth are depressed, the under-lip rises, the eye-lids fall down, the pupil is elevated, and half concealed under the eye-lid: the other muscles of the face are relaxed, which enlarges the space between the mouth and the eyes; and, of course, the countenance appears to be stretched out beyond its ordinary length.

In consternation and terror, the brow is wrinkled, the eye-brows are elevated, the upper eye-lid opens so wide that it rises above the pupil, and uncovers a part of the white above the pupil, which last falls down, and is partly concealed by the under-lid. The mouth, at the same time, opens wide, the lips recede from each other, and expose the teeth both above and below.

In contempt and derision, one corner of the upper-lip rises, and leaves the teeth bare; the other corner moves a little, and has the appearance of a malignant smile; the nostril next the elevated side of the lip shrivels up, and the angle of the mouth falls down. The eye on the same side is almost shut, while the other remains open; and both pupils are depressed in the same manner as when a person looks down from a height.

In jealousy, envy, and malice, the eye-brows fall down and are wrinkled; the eye-lids rise, and the pupils fall down; the upper lip is elevated on both sides; the angles of the mouth sink a little, and the middle of the under-lip rises and joins the middle of the upper one.

In laughing, the angles of the mouth are drawn back, and somewhat elevated; the upper part of the cheeks rise; the eyes are more or less shut; the upper lip rises and the under one sinks; the mouth opens; and, when the laughter is immoderate, the skin of the nose wrinkles.

Beside these marks, the arms, the hands, and the whole body, contribute to the expression of the passions. Gesture also concurs with the action of the features in expressing the different emotions of the soul. In joy, for example, the eyes, the head, the arms, and whole body, are agitated with quick and various movements. In languor and grief, the eyes are sunk, the head reclines, the arms hang down, and the whole body remains fixed and immoveable. In admiration, surprise, and astonishment, every motion is suspended, and the person remains in the same uniform attitude. These expressions of the passions are involuntary: but there is another species of expression, which consists in an agitation of the eyes, head, arms, and body; and these motions seem, at the same time, to be the effect of reflection, and to depend on the will. They appear to be efforts of the mind to defend the body, and may be regarded as secondary symptoms, by which particular passions may be distinguished. In love, hope, and keen desire, we elevate the head, and turn towards heaven, as if imploring possession; we stretch forward the head to make a nearer approach; and we extend the arms and open the hands, in order to seize and embrace the beloved object. On the other hand, in fear, hatred, and horror, we push the arms forward with precipitation, to repel the object of our aversion; we turn back the head and the eyes; we recoil, and at last fly, in order to avoid it. These motions are so sudden, that they appear to be involuntary: but this deception is the effect of habit; for these motions are produced by reflection, and, by their alacrity, discover the perfection of those qualities of the body which enable it to obey, with such amazing promptitude, the commands of the mind.

As the passions are agitations or movements of the mind, for the most part connected with impressions of sensation, they may be expressed by motions of the body, and particularly by those of the countenance. We can, therefore, form a judgment of the affections of the mind by the motions of the body, and can discover the real situation of the soul by examining the changes in the features of the face. But, as the mind has no figure which can have any relation to that of matter, we can form no judgment of the general disposition of any mind by the features of the countenance, or by the figure of the body with which it is connected. A deformed body may contain an amiable mind; neither should we pronounce concerning the natural disposition of any person, merely because the features of his countenance are not agreeable; for there is no analogy between features and the nature of the soul, upon which any reasonable conjectures can be founded.

The ancients, however, were much addicted to this false notion; and there have not been wanting in every age, men who wished to support a scientific divination derived by a pretended skill in physiognomy. But nothing is more evident, than that this species of divination can be extended no farther than to the affections of the mind, when expressed by the motion of the eyes, visage, and other parts of the body: the form of the nose, of the mouth, and of other features, has no more connection with the natural disposition of any person, than the stature, or size of the limbs, with the faculty of thinking. Has a man more genius in proportion as his nose is well made? Is the ability of another more circumscribed, because his eyes are small and his mouth large? It must, therefore, be acknowledged, that the

divination of physiognomists is altogether chimerical, and destitute of any foundation in nature.

The ears, of all the parts of the head, contribute least to the expression of the face. They are placed at a side, and commonly concealed under the hair. But, in quadrupeds, the ears are more apparent; and by them we can discover whether the creatures be in a state of vigour or of imbecility: their motions denote sentiment, and correspond to the internal feelings of the animal. The human ears, though furnished with muscles, have hardly any motion, either voluntary or involuntary. Small ears are said to be most beautiful; but large ones are better calculated for hearing. Some nations greatly enlarge the lobs of their ears, by piercing them, and placing in them pieces of wood or metal, which they change successively for others of greater dimensions, till the holes become enormous; and the lobes uniformly increase in proportion to the size of the holes. I have seen these round pieces of wood, which had been brought from India or South America, of more than an inch and a half in diameter. It is difficult to investigate the origin of this singular custom; but it is equally difficult to trace the origin of piercing the ears, (a practice almost general), and sometimes the nostrils, in order to adorn them with rings, &c. unless we attribute it to those naked savages who contrived to carry, in the least incommodious manner, such things as appeared to them to be most precious.

But the whimsical varieties in the customs of different nations are still more apparent in the manner of dressing and wearing their beards. The Turks shave their heads; but allow their beards to grow. Most Europeans, on the contrary, shave their beards, and wear their own or borrowed hair. The savages of America pull out the hairs of their beards, but carefully preserve those of the head. The negroes shave their heads in different figures; sometimes they cut their hair in the shape of little stars, sometimes in the manner of a friar, but most commonly in alternate stripes. The Talapoins of Siam shave the heads and eye-brows of those children whose education is entrusted to them. In this article every nation has different usages. Some prefer the hair on the upper lip to that of the chin; others esteem hair on the cheek; some curl it, and others wear it straight. It is not long since we wore our hair behind loose and floating; we now inclose it in a bag. Our dress is different from that of our fathers. The differences in dress are as various as the different nations of the globe: and, what is singular, we have adopted that dress which is most incommodious, wastes most time in adjusting, and is least agreeable to nature.

Though fashions seem to be founded on caprice and fancy; yet, when generally adopted, they merit examination. Men have always given a value to those things which excite attention, and which convey flattering ideas of riches, power, and grandeur. The value of diamonds, and other precious stones, arises from their scarceness and brilliancy. The same observation applies to those shining metals, the weight of which we regard so little, that, for the sake of finery, we spread them over our garments. Ornaments of this kind are intended to excite the attention of spectators, to give them an idea of splendour and wealth, and to dazzle their fancies: how few have the capacity of distinguishing the person from the dress, or of estimating the man in any other manner than by the metal on his clothes!

Every thing that is rare and brilliant will, therefore, always be fashionable, while men derive more eminence from riches than virtue, and while the means of acquiring respect continue so widely different from real merit. Strangers receive their first impressions of us from our dress, which is varied according to the points of view in which we wish to be considered. The modest man, or he who wishes to assume that character, dresses with a simplicity corresponding to the nature of that virtue. The vain-glorious, on the contrary, neglect nothing that can support their pride, or flatter their vanity; and they distinguish themselves by splendour or fineness in their external appearance.

Another very general object of dress is to increase the size of our figure, and to occupy more room in the world than nature has allotted to us. We wish to enlarge our dimensions by high-heeled shoes and blown-up garments; but, however bulky our dress, it is exceeded by that vanity which it endeavours to cover. Why is the doctor's head loaded with an enormous quantity of borrowed hair, while that of the beau is so thinly covered? The former wishes to have the extent of his learning measured by the apparent dimensions of his head; and the latter desires to diminish his head, that he may exhibit the gaiety and sprightliness of his genius.

Other fashions appear to have a more rational object, namely to conceal the defects of nature, or to render them less disagreeable. Taking mankind in general, there is a greater number of deformed bodies, and disagreeable faces, than of handsome figures, and beautiful countenances. Fashions are always regulated by the practice of the majority; and, as the greatest part of mankind have defects to conceal, it is their interest to invent and support those modes which tend to render their deformities less conspicuous. Women never think of paint, till the natural bloom of their cheeks is faded. Painting, however, is a very general custom. The mode of whitening the hair with powder, and curling it, is not so universal; but it seems to have been intended for the same pupose, to make the colours and features of the countenance appear with greater advantage.

But, leaving external ornaments, and the drapery of the picture, let us return to the figure itself. The head

of man is differently constructed, both internally and externally, from that of any other animal. The head of the monkey makes the nearest approach; its brain, however, is proportionally less; and there are other differences, to be afterwards pointed out. The bodies of almost all quadrupeds are entirely covered with hair. In man, the head alone has this ornament before the age of puberty, and it is more amply furnished with hair than the head of any other animal. The monkey resembles man very much in his ears, nose, and teeth.

Among animals, there is a great diversity in the size, position, and number of their teeth. Some are furnished with teeth in both jaws; others have them in the under jaw only; in some they are widely separated from each other; and are close and united in others. The palate of some fishes is a hard bony plate, stuck full of sharp points, which perform the office of teeth.

The mouths of most animals are armed with some solid substance, which enables them to apprehend or grind their food. The teeth of men, quadrupeds, and fishes, the beaks of birds, the pinchers, saws, &c. of insects, are all hard instruments, and, like the nails, horns, and hoofs, derive their origin from the nerves. We formerly remarked, that nerves, when exposed to the air, acquire a surprizing hardness. As the mouth gives a free access to the air, it is therefore natural to think that the nerves which terminate there should harden, and produce the teeth, the bony plate, the beak, the pinchers, and all the other solid parts of animals.

The neck supports the head, and unites it to the body. It is larger and stronger in most quadrupeds than in man. Fishes, and other animals which are not furnished with lungs similar to ours, have no neck. Birds, in general, have longer necks than other animals. Those birds which have short claws have likewise short necks, and *vice versa*. Aristotle says, that birds of prey which have pounces are all short necked.

The human breast is proportionally larger than that of other animals; and none but man and the monkey have collar-bones. The breasts of women are larger and more prominent than those of men: but their consistence and structure are nearly the same; for the breasts of men can secrete milk. There are many examples of this fact; and it commonly happens at the age of puberty. I have seen a young man of fifteen years squeeze more than a spoonful of milk out of one breast. Among animals there is a great variety in the number and situation of their paps. Some, as the monkey and elephant, have only two placed on the fore part of the breast; others have four, as the bear; others, as the sheep, have only two situated between the hinder legs; others have them in great numbers upon the belly, as the bitch and the sow. Birds, and all the oviparous animals, have no paps. Viviparous fishes, as the whale, the dolphin, &c. have breasts, and suckle their young. The form of the breasts varies in different animals, and even in the same animal at different ages. It is alledged, that women, whose breasts are shaped like a pear, make the best nurses, because the mouth of the child comprehends not only the nipple, but part of the breast itself.

Below the breast is the belly, in which the navel makes a conspicuous figure. In other animals it is hardly perceptible; and even the monkey has nothing in place of it but a kind of callosity.

The arms of man have little resemblance to the fore feet of quadrupeds, and still less to the wings of birds. The monkey tribe are the only animals which have arms and hands; but their structure is more rude, and their proportion less exact than those of man; his shoulders are likewise larger, and differently constructed from those of any other animal; and it is on the top of the shoulders that he can bear the heaviest burdens.

The form of the back differs not much from that of some quadrupeds; the region of the reins is indeed more muscular and strong. But the buttocks are peculiar to the human body; the thighs of quadrupeds are often mistaken for the buttocks, though they be totally different. Man being the only animal who can support himself perfectly erect, the swelling or cushion on the top of his thighs, is necessary to sustain him in that posture.

The human foot is very different from that of all other animals, the monkey not excepted. The foot of the ape is rather a kind of hand; its toes are long, and situated like fingers, the middle one being by much the longest; and it has no heel. The sole of the foot is likewise larger in man, and his toes are better adapted for preserving the equilibrium of the body in walking, running, dancing, and other movements.

The human nails are less than those of other animals. If they protruded much beyond the points of the fingers, they would obstruct the dexterity of the hand. Those savages who allow them to grow to an unnatural length, use them for flaying and tearing animals. But, although their nails be stronger and longer than ours, they can by no means be compared to the hoofs or claws of other animals.

With regard to the proportions of the human body, we have no exact knowledge. The same parts have not the same proportions in any two individuals; and, even in the same person, the corresponding parts are not perfectly similar. For example, the right arm or leg have seldom the same dimensions with the left. Repeated observations alone can ascertain a standard by which we may be enabled to form a perfect idea of the natural and best proportions of the human figure. It is not by comparing men, or taking their dimensions, that we are to expect any light upon this subject: we have more to hope from the art of designing, and the efforts which

have been made in imitating Nature. Taste and sentiment have exceeded the limits of mechanical operations. The square and compass are laid aside, and we trust more to the impressions made on the senses. Every possible form has been realized in bronze or in marble. We recognize the standard of Nature more by imitating her, than by her own productions; and we judge better concerning the perfection of a statue by viewing it, than by taking its different dimensions. It is by long practice in the art of designing, and by delicacy of sentiment, that eminent statuaries have been enabled to make men feel the justness of proportion in the works of Nature. The ancients made statues so exquisitely fine, that they have uniformly been regarded as exact representations of the most perfect human figures. These statues, which were only copies of the human form, are now considered as originals; because they were not imitated from an individual, but from the whole species, so attentively compared and diligently observed, that it is impossible to find an equal degree of symmetry and proportion in any one man that ever existed. We shall, therefore, relate the dimensions of the different parts which these artists have fixed as standards of perfection. They commonly divide the height of the body into ten times the length of the face; they likewise divide each *face*, or tenth of the body, into three equal parts; the first commences at the springing of the hair on the forehead, and terminates at the root of the nose; the nose is the second division; and the third extends from the nose to the end of the chin. In measuring the rest of the body, they use the term *nose*, or length of the nose, to denote the third of a face, or the thirtieth part of the body. The first face begins at the root of the hair above the forehead, and extends to the end of the chin; but, from the top of the forehead to the crown, there is still a third of a face, or a nose, in height. Thus, from the top of the head to the end of the chin, there is a face and a third; from the chin to the juncture of the clavicles, two thirds of a face; and, therefore, from the top of the breast to the crown of the head, is twice the length of the face, or the fifth of the body; from the joining of the clavicles to the under part of the paps, they reckon one face; from this to the navel is a fourth face; and the fifth extends from the navel to the division of the inferior extremities, which should complete half the length of the body. Two faces are exhausted between the thigh and knee, to the last of which they allow half a face, being the first half of the eighth face; two faces are assigned between the knee and top of the foot, and from that to the sole half a face, which completes the ten faces, or length of the body. This division has been made from men of ordinary size; but, in those of a higher stature, they allow about half a face additional between the paps and the commencement of the thighs, which, in tall men, is not the middle of the body. When the arms are fully stretched in a horizontal line, the space between the tops of the middle fingers is equal to the length of the body. From the joining of the collar-bone to the articulation of the shoulder-bone with that of the arm, is one face. When the arm hangs down, or is bended forward, it is four faces in length; two between the joint of the shoulder and the elbow, and two between the elbow and the root of the little finger, in all five faces, and an equal number for the other arm, which is precisely the length of the body; about half a face remains for the length of the fingers; but it must be remarked, that half a face is lost in the joints of the elbows and shoulders, when the arms are extended. The hand is about a face in length, the thumb a third of a face, or a nose, and the longest toe is of the same length with the thumb. The under part of the foot is equal in length to the sixth part of the height of the body. For the reasons already mentioned, if an experiment be made of these dimensions upon any individual, they will appear to be extremely imperfect. It is still more difficult to fix the proportional thickness of the different parts of the body. The changes are so great when the same man is meagre or in good case, and the action of the muscles in different positions, creates so much variety in the dimensions of the parts, that it is almost impossible to give any determined rules upon this subject.

The superior parts of the body, in infancy, are larger than the inferior; the thighs and legs are not nearly equal to half the length of the whole body; as the child advances in years, the inferior parts grow more in proportion than the superior; and, when the growth is complete, the thighs and legs are very nearly one half the length of the body.

The anterior parts of the chest, in women, is more elevated, and its diameter larger, than in men; but the chests of the latter are proportionally broader. The haunches of women are likewise larger than those of men; because the haunch-bones of women, and those which join them and compose the pelvis, are proportionally larger. These differences in the structure of the chest and pelvis are so perceptible, that it is easy, by this criterion, to distinguish the skeleton of a woman from that of a man.

There are great varieties in the length of men. Those are said to be tall who are from five feet eight inches to six feet high. The middle stature is from five feet five to five feet eight; and those who fall below these dimensions are said to be of small stature. Women, in general, are two or three inches below the standard of men. Of giants and dwarfs, notice shall be taken in another place.

Though the human body be externally more delicate, it is, however, very nervous, and perhaps stronger, for its size, than the most robust quadruped. In comparing the force of a lion to that of a man, it ought to be

considered, that the lion is armed with teeth and talons; and that these dreadful weapons convey a false idea of real strength. The arms which Man has received from Nature are not offensive; and happy had it been if art had never put into his hands weapons more destructive than the claws of the lion.

But there is a juster method of instituting a comparison between the strength of a man and that of the other animals, namely, by the weight they are able to carry. It is affirmed, that the porters of Constantinople can carry burdens of nine hundred pounds weight; and Desaguliers tells us, that, by means of a certain harness, by which every part of a man's body was proportionably loaded, the person he employed in this experiment was able to support, in an erect posture, a weight not less than 2000 pounds. A horse, which is about six times the size of an ordinary man, ought, therefore, when managed in the same manner, to bear 12,000 or 14,000 pounds; an enormous weight, in comparison of what that animal can support, even when it is distributed with every possible advantage.

The strength of animals may likewise be estimated by agility and perseverance in labour. Men, when accustomed to running, outstrip horses, or at least continue their speed much longer; and a man will accomplish a long journey sooner, and be less fatigued than even the best road horses. The royal messengers of Ispahan, who are trained to running, go 36 leagues in 14 or 15 hours. We are assured by travellers, that the Hottentots outrun lions in the chace; and that those savages who live upon hunting, pursue and even catch deer, and other animals of equal swiftness. Many other stories are told of the amazing nimbleness of savages, of the long journeys they accomplish on foot, over the most craggy mountains, where there is no path to direct, and every obstacle to obstruct their progress. These people are said to travel 1000 leagues in six weeks, or at most two months. If we except birds, whose muscles are proportionally stronger than those of any other animal, no other creature could support such long continued fatigue. The civilized man is ignorant of his own strength; nor is he sensible how much he is weakened by effeminacy, nor to what extent he might recover his native force by an habitual and vigorous exercise of his powers.

Men of extraordinary strength sometimes appear. But this gift of nature, which would be highly valuable in the savage state, is of little use among polished nations, where more depends on mental than corporeal powers, and where manual labour is confined to the inferior orders of men.

Men are much stronger than women; and they have too often employed this superiority in exercising a cruel and tyrannical dominion over the weaker sex, who were entitled to share with them both the pleasures and the pains of life. Savage nations condemn the women to perpetual labour. They cultivate the ground, and perform every office of drudgery, while the men indolently recline in their hammocks, from which they never think of stirring, unless when they go a hunting or fishing; and, so averse are they to motion, that they have often been known to stand in the same position for several hours. A savage has no idea of walking for amusement; and nothing astonishes him more than to see Europeans walking backwards and forwards in quest of nothing. All men are naturally indolent; but the savages of warm countries are not only the most lazy of human beings, but the most tyrannical to their women, whom they treat with a cruel barbarity. In nations more civilized, men dictate laws to the women. These laws are always more severe in proportion to the grossness of the national manners; and it is only among people highly polished that women have obtained that equality of condition which is due to them, and which contributes so powerfully to the happiness of society. This politeness of manners is the genuine offspring of the softer sex; they have opposed it to the arms of the victor, while their modesty has taught us to acknowledge the empire of beauty, a natural advantage greatly superior to mere strength. But, to give it full force and value, requires the assistance of art; for the ideas of beauty are so different, so capricious, and even contradictory, that the women, it is probable, have gained more by the art of making themselves amiable, than by beauty itself, of which men form such opposite judgments. Men are agreed as to the ultimate object of their passion for the other sex, the estimation of which is augmented by the difficulty of acquisition. The beauty of women commenced the moment they learned to make themselves respectable, by refusing all approaches to their hearts which proceeded not from delicacy of sentiment; and, whenever the influence of sentiment was felt, polished manners were a necessary consequence.

The taste of beauty, among the ancients, differed widely from ours. With them, a small forehead and joined eye-brows were charming features in a female countenance; and, in Persia, large joined eye-brows are still highly esteemed. In some Indian countries, black teeth and white hair are necessary ingredients in the character of a beauty; and in the Marian Islands it is a capital object with ladies to blacken their teeth with herbs, and to bleach their hair with certain liquors. Beauty, in China and Japan, is composed of a large countenance, small and half concealed eyes, a broad nose, minute feet, and a prominent belly. Some Indians of America and of Asia compress the heads of their children between two wooden planks, with a view to enlarge and beautify the face; others compress them laterally, others depress the crown only, and others make the head as round as possible. Every nation has ideas of beauty peculiar to itself; and every individual

has his own notions and taste concerning that quality. These peculiarities probably originate from the first agreeable impressions we receive of certain objects; and therefore depend more upon chance and habit than upon difference of constitution. When we come to treat of the senses, we shall perhaps be able to give more determined ideas concerning those perceptions of beauty we receive by the eye.

SECTION V.

Of Old Age and Death.

EVERY object in nature must change and decay. The bodies of men no sooner arrive at full maturity, than they instantly begin to decline. The waste is at first insensible; several years frequently revolve before we perceive any considerable alteration. But we ought to feel the weight of our years, better than their number can be estimated by strangers; and, as those are seldom deceived who judge of our age by external characters, we would be still more sensible of it from what passes within us, if we were more attentive to our feelings, and deceived not ourselves by vanity and fallacious hopes.

When the body has acquired its full length, it increases in thickness: the commencement of this augmentation is the first step towards decay; for this extension is not a continuation of growth, which would communicate force and activity, but merely an addition of superfluous matter, that blows up the body, and loads it with a useless weight. This matter, which is denominated fat, generally appears at the age of 35 or 40 years; and, in proportion as the quantity of it augments, the body loses its former lightness and freedom of motion; its generative faculty is diminished; its members turn unwieldy; and it acquires extension at the expence of strength and activity.

Besides, the bones increase in solidity; the nutritious juices, which formerly served to expand the bones, now increase their quantity of matter only, by filling up their internal cavities; the membranes are changed into cartilages, and the cartilages into bones; the fibres of the muscles grow rigid; the skin is deprived of its moisture, and wrinkles are gradually formed in it; the hair turns hoary; the teeth fall out; the visage assumes a haggard appearance, the body bends forward, &c. The first approaches of this state are perceptible before the age of 40; they advance by slow degrees till 60, and more rapidly from that to 70, when decrepitude commences, and continues to augment till 90 or 100, when death puts a final period to our existence.

We shall now take a more particular survey of these changes; and, as we have inquired into the causes of the growth and expansion of the human body, let us also investigate those of its decay and dissolution. At the commencement of our existence, the bones are only small fibres, of a soft and ductile substance, and gradually acquire consistence and solidity. They may be considered, in their original state, as small tubes lined, both within and without, with a thin membrane: this double membrane furnishes the osseous matter; for the small interval between the internal and external periosteum is soon converted into a bony plate. Some idea of the production and growth of bones may be formed, by comparing them with the manner in which wood and the more solid parts of vegetables are produced. We shall take, for example, the fig-tree or the alder, which are at first hollow in the middle, like the thigh and other hollow bones of the body. When a bud, that is to form a branch, begins to extend, it is only a soft, ductile matter, which, by extension, becomes a slender herbaceous tube filled with pith. The external and internal surfaces of this tube are covered with a fibrous membrane, as well as the internal partitions by which the cavity is divided. These membranes, however thin, are composed of several plates of fibres, lying above each other, which are still soft, but gradually harden by depositing the sap which they absorb for their nourishment; and by this means a woody plate is formed, during the first year, between the two membranes, which is more or less thick in proportion to the quantity of sap that has been deposited between the external and internal membranes. But, though each of these membranes become woody internally, their external surfaces remain soft and ductile; and, the following year, when the bud at the top of the branch begins to expand, the sap rises through the soft fibres of each membrane, and converts them, by its sediments, into other woody plates. The same process goes on annually; and, in this manner, the tree or branch gradually increases in thickness.

The internal cavity likewise augments in proportion to the growth of the branch; because the internal membrane extends along with the other parts, and the woody plates are only applied successively to the plates already formed. If we examine a branch, or a joint, which has been the product of one year, we shall find, that it uniformly preserves the same figure through all the stages of its growth. The joints or knots which mark the production of each year, become fixed points for the reaction of those powers that expand the contiguous parts during the following year. The superior buds re-act against these points, and, by expanding themselves, form new branches or joints in the same manner as the first were produced.

The process of ossification would be very similar to that we have now described, if the fixed points of the bones began at the extremities, in place of the middle. At first the bones of the fœtus are only small threads, or tubes, of a ductile matter, which are easily perceived through the delicate and transparent skin. The thigh-bone, for example, is then a small short tube, like the herbaceous tubes above described. This tube is shut at both ends by a pulpy substance, and its external and internal surfaces are covered with two membranes composed of several layers of soft and ductile fibres. In proportion as this tube receives nutritious juices, the two extremities extend and receive from the middle point, which always preserves the same station. The extremities cannot extend without reacting against this middle point; and the parts which are nearest it begin first to acquire solidity. The first bony plate, like the first plate of wood, is produced in the interval which separates the two membranes or periostea. But the ossification commences in the middle, and gradually extends to the extremities, which remain soft long after the middle parts are converted into bone. The middle parts of bones, therefore, being first ossified, it is impossible that they should afterwards expand equally with those parts which remain longer in a soft and ductile state. This is the reason why bones are always thinnest in the middle, and thickest at the extremities. But, independent of this difference between the longitudinal growth of bones and of wood, the analogy between their increase in thickness is very striking: for the first bony plate is produced from the internal part of the periosteum; and, after the formation of this plate between the two periostea, two other plates are soon formed, one on each side of the first, to which they adhere; and, by this means, both the circumference of the bone, and the diameter of its cavity, are augmented. Thus the interior parts of the two periostea continue successively to produce bony plates, in the same manner as woody plates are produced from the bark of vegetables.

But, after the bone has acquired its full growth, after the periostea cease to furnish osseous matter, then the nutritious juices, which were formerly employed in augmenting the bulk of the bone, serve only to increase its density. These juices are deposited in the internal parts of the bones, and give them more weight and solidity, as may easily be perceived by comparing the weight and density of an ox with those of a calf. The substance of the bones become, in process of time, so compact, as not to admit the circulation of those juices which are necessary for their support and nourishment. This substance, therefore, must now undergo a change similar to that which takes place in old trees, after they have acquired their full solidity; and this change is one of the first causes which render the dissolution of the human body inevitable.

The cartilages, which may be regarded as soft and imperfect bones, likewise receive nutritious juices, which gradually augment their density. They become more and more solid as we advance in years; and, in old age, they are almost as hard as bones. This rigidity of the cartilages renders the motion of the joints extremely difficult, and, at last, deprives us of the use of our members, and produces a total cessation of external movements. This is a second, and more marked cause of death, because it manifests itself by a laborious performance of the common actions of the body.

The membranes likewise become hard and dry, as we advance in years. Those, for example, which surround the bones, soon lose their flexibility. At the age of 20, they are incapable of farther extension. The muscular fibres suffer a similar change, in proportion to the time of life; though, to the touch, they seem to be softer as age increases. It is not the muscles, however, but the skin, that occasions this perception. After the body is come to its full growth, the fat increases, and, by being interposed between the fibres of the muscles, and between the skin and the muscles themselves, makes them feel softer, when, in reality, their density is greatly increased. Of this fact we have an incontestible proof, by comparing the flesh of young with that of old animals. In the former, it is tender and delicate; but, in the latter, it is dry, hard, and unfit for eating.

The skin always extends as the body increases; but, when the body diminishes, the skin has not elasticity enough to enable it to contract to its former dimensions: it, therefore, continues in wrinkles and folds, which can never be effaced. The wrinkles of the face partly arise from this cause; but, in their production, they have a relation to the form, to the features, and to the habitual motions of the countenance. If we examine the face of a man of 25 or 30 years of age, we may trace the origin of all the wrinkles which will appear in old age, especially when he laughs, cries, or makes any violent grimace. All the folds which are exhibited in these actions will in time become indelible wrinkles.

In proportion as we advance in years, the bones, the

cartilages, the membranes, the flesh, the skin, and every fibre of the body, become more solid, hard, and dry. Every part shrinks and contracts; and every movement is performed with slowness and difficulty: the circulation of the fluids is sluggish and interrupted; perspiration is diminished; the secretions change; digestion becomes slow and laborious; the nutritious juices are less abundant, and, being rejected by parts which are already too dense, they communicate no supplies. These parts, therefore, may be regarded as already dead, because they have ceased to receive nourishment. Thus the body dies by inches; its motions gradually decay; life wears away by imperceptible degrees; and death is only the last term in the series.

As, in women, the bones, the cartilages, the muscles, and every other part of the body, are softer and less solid than those of men, they must require more time in hardening to that degree which occasions death: women, of course, ought to live longer than men. This reasoning is confirmed by experience; for, by consulting the bills of mortality, it appears, that, after women have passed a certain age, they live much longer than men who have arrived at the same age.

From what has been said, it may also be concluded, that men who have a weakly appearance, and approach nearer to the constitution of women, should live longer than those who are more robust; and likewise, that persons of either sex, who are long before they arrive at their full growth, should outlive those who advance more rapidly to that point; because, in this case, the bones, cartilages, and fibres, are later in arriving at that degree of solidity which is necessary to their destruction.

This natural cause of death is common to all animals, and even to vegetables. An oak perishes only because the oldest parts of the wood, which are in the centre, become so hard and compact, that they can receive no further nourishment. The moisture they contain being deprived of circulation, and not being replaced by fresh supplies, ferments, corrupts, and gradually reduces the fibres of the wood into powder.

The duration of life may, in some measure, be computed by the time occupied in growth. A plant or an animal that acquires maturity in a short time, perishes much sooner than those which are longer in arriving at that period. In animals, as well as vegetables, the longitudinal growth is first finished. Man grows in stature till he be 16 or 18 years of age; but his body is not completely unfolded in thickness before that of 30. Dogs acquire their full length in less than one year; but their growth in thickness is not finished till the second year. A man, who grows 30 years, lives till 90 or 100; and a dog, whose growth terminates in two or three years, lives only 10 or 12. The same observation may be applied to most animals. Fishes continue to grow for a great number of years; they accordingly live for centuries; because their bones never acquire the density of those of other animals. When we give the particular history of animals, we shall examine whether there be any exception to this rule, which Nature seems to follow in proportioning the duration of life to the time of growth, and whether crows and stags live so long as is commonly imagined. But it may be laid down as a general fact, that large animals live much longer than small animals, because they require more time to finish their growth.

Thus the causes of our dissolution are inevitable; and it is equally impossible to retard that fatal period, as to change the established laws of Nature. The ideas of those visionaries, who conceived the possibility of perpetuating human life by the use of certain medicines, would have perished with themselves, if self-love did not always induce us to believe what exceeds the powers of Nature, and to be sceptical with regard to the most certain and invariable truths. The universal panacea, the transfusion of the blood, and other methods which have been proposed to render our bodies immortal, are as chimerical as the fountain of youth is fabulous.

When the constitution is sound, life may, perhaps, be prolonged for a few years, by moderating the passions, and by temperance. But even this is a difficult point; for, if it be necessary that the body should exert its whole force, and that it should waste all its powers by labour and exercise, what advantages can we derive from regimen and abstinence? Some men have indeed exceeded the ordinary term of human life: without mentioning those extraordinary instances of longevity recorded in the Philosophical Transactions, such as that of Par who lived to the age of 144, and of Jenkins who lived 165 years, we have many examples of the prolongation of life to 110, and even 120. These men, however, used no peculiar arts for the preservation of their bodies. They appear, on the contrary, to have been peasants, huntsmen, labourers, and people accustomed to abuse their bodies, if it be possible to abuse them by any other means than those of continual idleness and debauchery.

Besides, the varieties of climate, and of the modes of living, make no difference as to the period of our existence, which is the same in the European, the Negro, the Chinese, the American, the civilized man and the savage, the rich and the poor, the citizen and the peasant. Neither does the difference of races, of food, or of accommodation, make any change on the duration of life. Men who feed upon raw flesh or dried fish, on sago or rice, on cassada or roots, live as long as those who are nourished with bread and prepared victuals. It is apparent, therefore, that the duration of life has no dependence either on manners or customs, or the qualities of particular food: if luxury and intemperance be

excepted, nothing can alter those laws of mechanism which regulate the number of our years.

Any little differences which may be remarked in the term of human life seem to be owing to the quality of the air. There are generally more old men in high than in low countries. The mountains of Scotland, of Wales, of Auvergne, and of Switzerland, have furnished more examples of extreme old age than the plains of Holland, Flanders, Germany, or Poland. But, taking mankind in general, there is hardly any difference in the duration of life. When men are not cut off by accidental diseases, they every where live 90 or 100 years. Our ancestors never exceeded this period; and, since the age of David, it has suffered no variation. If it should be asked, why the first races of men lived 900, 930, and even 969 years? we may, perhaps, be able to give a satisfactory answer. The productions of the earth were then of a different nature. The surface of the globe, as we remarked when treating of the Theory of the Earth, was, in the first ages of the world, less solid and compact; because, gravity having acted for a short time only, terrestrial bodies had not acquired their present density and consistence. The produce of the earth, therefore, must have been analogous to its condition. The surface being more loose and moist, its productions would, of course, be more ductile and capable of extension: their growth, therefore, and even that of the human body, would require a longer time of being completed. The softness and ductility of the bones, muscles, &c. would probably remain for a longer period, because every species of food was more soft and succulent. Hence, the full expansion of the human body, or when it was capable of generating, must have required 120 or 130 years; and the duration of life would be in proportion to the time of growth, as is uniformly the case at present: for, if we suppose the age of puberty, among the first races of men, to have been 130 years, as they now arrive at that age in 14 years, the age of the antediluvians will be in exact proportion to that of the present race; since, by multiplying these two numbers by seven, for example, the age of the present race will be 90, and that of the antediluvians will be 910. The period of man's existence, therefore, may have gradually diminished in proportion as the surface of the earth acquired more solidity by the constant action of gravity; and it is probable, that the period from the creation to the days of David, was sufficient to give the earth all the density it was capable of receiving from the influence of gravitation; and, consequently, that the surface of the earth has ever since remained in the same state, and that the terms of growth, in the productions of the earth, as well as in the duration of life, have been invariably fixed from that period.

Independent of accidental diseases, which are more frequent and dangerous in the latter periods of life, old men are subject to natural infirmities, that originate solely from the decay of the different parts of the body. The muscles lose their tone, the head shakes, the hands tremble, the legs totter, the sensibility of the nerves decreases, and every sense is blunted. But the incapacity for generating is the most characteristic infirmity of old age. This impotency may be ascribed to two causes; an alteration in the seminal fluid, and a want of tension in the external organs. The defect of tension is easily explained from the conformation of the organ itself, which is a spongy cavernous substance, fitted to receive into its cavities a great quantity of blood, in order both to increase its size, and to render it more rigid. In youth, this organ is soft and flexible; and, of course, it is easily extended by the impulse of the blood. But, as we advance in years, like every other part of the body, it becomes more solid, and loses its flexibility. Hence, though the impulse of the blood were equal to what it was in youth, this impulse is unable to dilate an organ which has become too dense to admit blood in a quantity sufficient to produce an erection that will answer the purposes of generation.

With regard to the change, or rather sterility of the seminal fluid, it cannot be prolific unless when it contains organic particles transmitted from every part of the body; for we have already shown, that the production of a small organized being, similar to its parent, cannot be effected without the union of the organic particles sent from all parts of the body. But, in very aged men, the parts have become too solid, and can neither receive, assimilate, nor transmit the nutritive and prolific particles. The bones and other solids, therefore, can neither produce nor transmit organic particles correspondent to their own natures; these particles must, of course, be wanting in the seminal fluids of old men; and this defect is sufficient to render them incapable of generating.

But, admitting the sterility of old men to be owing to a defect in the organic particles of their seminal fluids, this defect may still be supplied by a young woman, which not unfrequently happens; for old men sometimes, though rarely, generate; and, when they do produce, they have a much smaller share in their children than young men. This is likewise one reason why young women, who are married to old, decrepid, and deformed men, often produce monsters, or children still more deformed than their fathers. But this is not a proper place for such discussions.

The greatest part of mankind die of the scurvy, the dropsy, or other diseases which seem to proceed from a vitiation of the blood and other fluids. Whatever influence the fluids may have in the animal œconomy, they are only passive and divisible substances, and obey the impulses of the solids, which are the true organic active parts, and upon which the motion, the quality, and even the quantity of the fluids entirely depend. In old age, the cavities of the vessels contract, the muscles

lose their tone, the secretory organs are obstructed; the blood, the lymph, and the other fluids, of course, grow viscid, extravasate, and produce all those diseases and symptoms which are usually ascribed to a vitiation of the humours. But the natural decay of the solids is the original cause of these maladies. Though it be true, that the bad state of the fluids proceeds from a depravity in the organization of the solids; yet the effects resulting from a change in the fluids produce the most alarming symptoms, if they become stagnant, or if they be obstructed in their circulation by the contraction of the vessels; if, by the relaxation of the vessels, they extravasate, they must soon corrupt, and corrode the weaker parts of the solids. In this manner the causes of destruction perpetually multiply; our internal enemies grow more and more powerful, and at last put a period to our existence.

All the causes of decay which I have mentioned, act continually upon the human body, and gradually lead to its dissolution. Death, which appears so terrible to us, is the last term only in the series of evils. Life begins to decay long before it is entirely extinguished: and the changes are perhaps greater from youth till the beginning of our decay, than from decrepitude to death; for we ought here to consider life as a subject capable of augmentation and of diminution. When the fœtus is first formed, the quantity of life is almost equal to nothing; it gradually extends and acquires consistence and force, in proportion to the growth and expansion of the body. On the other hand, when the body begins to decay, the quantity of life diminishes, till its final extinction. Thus life both commences and terminates by imperceptible degrees.

Why then should we be afraid of death, if we have no reasonable apprehensions of its consequences? Why dread this single moment, which has been preceded by an infinity of others of the same order: since death is fully as natural as life, and both arrive in the same manner, without our being able to perceive their approach? If we enquire of physicians, and those who are accustomed to observe the actions and sentiments of the dying, we shall find, that, except in a few acute diseases, attended with agitations and convulsions, which exhibit only the appearances of pain, most men expire quietly, and without the smallest indication of uneasiness. Even when patients seem to be afflicted with the most dreadful agonies, they have no existence but in the imagination of the spectator: the truth of this has been repeatedly attested by many people who have recovered after the most violent commotions and convulsions, who, notwithstanding, were unable to recollect a single pang they had felt, or a single idea or sentiment that had passed during this seemingly distressful situation.

The greatest part of mankind, therefore, die without being sensible of the fatal stroke; and of those who preserve their senses to the last groan, there is not, perhaps, one who does not entertain some hope of recovery. Nature, for the happiness of man, has rendered this principle much stronger than reason. Men never cease to flatter themselves with hopes of recovery, even though they might judge of their real condition from the example of others who had been afflicted with the same incurable disorders, from the tears of their friends, and from the countenances or desertion of their physicians. All these mortifying circumstances are only regarded as premature and ill-grounded fears; and hope never leaves us, till death shuts the scene.

A sick man tells you, that he feels the hand of death, that the king of terrors is just about to arrive, and that recovery is impossible: but if, from zeal or indiscretion, he is informed of his approaching dissolution, his countenance instantly changes, and he betrays all that uneasiness which naturally attends the first intimation of death. This man, it is evident, gives no credit to his own assertions. He may entertain some doubts concerning his situation; but his hopes are always superior to his fears: and, if he were not alarmed by that cruel parade of grief which too often imbitters the sick man's couch, he would never perceive the approach of his dissolution.

Death, therefore, is not that horrible object which we have fancied to ourselves. It is a spectre which terrifies us at a distance, but disappears when we approach it more closely. Our conceptions of it are founded on prejudice; and we regard it not only as the greatest of all misfortunes, but as accompanied with the most excruciating tortures. The pain, it is said, must be extreme when the soul separates from the body; its duration may also be long, since time is measured by the celerity of ideas; and one painful moment, by augmenting the rapidity of our ideas, may have the appearance of an age, when the train of ideas proceeds with their usual gentleness and tranquillity. This reasoning is such an abuse of philosophy, that, if it had no influence in increasing the miseries of human life, it merits nothing but silence and contempt. As such arguments, however, gain credit with weak minds, and render the aspect of death a thousand times more hideous than it really is, a refutation of them may be attended with utility.

When the soul is first united to the body, do we feel a joy that transports us? No. This union is effected without our perception; why then, should we be conscious of their dissolution? What reason have we to believe that the separation of the soul and body is attended with extreme pain? What cause should produce this pain? Does it reside in the soul or in the body? Pain of mind can only result from thought; and pain of body is always proportioned to its strength or weakness. At the approach of natural death, the body is in

its weakest state, and, of course, it can feel but very little, if any pain.

Let us now suppose a violent death: can the sufferings of a man, for example, whose head is carried off by a cannon-ball, be more than instantaneous; can the succession of his ideas, during this instant, be so rapid as to make the pain seem to continue for an hour, a day, or a century? We shall endeavour to discuss this point.

I acknowledge that the succession of our ideas is the only natural measure of time, and that we conceive it to be shorter or longer in proportion to the unifomity or irregularity of their motions. But, in this measure, there is a unit or fixed point, which is neither arbitrary nor indefinite, but is determined by Nature, and corresponds with the particular organization of individuals. Two ideas, which succeed each other, must necessarily be separated by an interval; one thought, however rapid, must require some portion of time before it can be followed by another. No succession can take place in an indivisible instant. The same remark is applicable to sentiment or feeling. A certain time must elapse in the transition from pain to pleasure, or from one painful sensation to another. This interval between our thoughts and sensations is the unit or fixed point formerly mentioned; and it can neither be extremely long nor extremely short, but must be nearly equal in its duration; because it depends on the nature of the mind and the organization of the body, the movements of which must have a determined degree of celerity. In the same individual, therefore, there can be no succession of ideas so rapid, or so slow, as to produce that enormous difference in duration, by which a momentary pain is prolonged to that of an hour, a day, or a century.

A very acute pain, if continued for a certain time, uniformly brings on either fainting or death. Our organs, which are endowed only with a certain degree of force, cannot resist more than a certain quantity of pain. If the pain becomes excessive, the organs are unable to support it; and, of course, they can transmit no intelligence of it to the mind, with which there is no correspondence but by the distinct action of these organs. In this case, the action of the organs is interrupted; and, consequently, all internal sensation is at an end.

What I have already remarked is perhaps more than is sufficient to evince, that the instant of death is neither accompanied with extreme nor long-continued pain. But, in order to eradicate the fears of the most timid of mankind, we shall still add a few words upon this subject. Excessive pain extinguishes all reflection, though symptoms of it have sometimes appeared in the very moment of violent death. When Charles XII. received the blow which terminated, in an instant, both his enterprises and his existence, he clapped his hand upon his sword. This mortal pang, since it excluded not reflection, could not be excessive. He found himself attacked; he considered that he ought to defend himself; it is evident, therefore, that he felt no greater pain than he would have suffered from an ordinary stroke. This action could not be the result of a mechanical impulse; for I have shewn, in the description of man, that the most precipitate movements of the passions depend upon reflection, and are nothing but habitual exertions of the mind.

I would not have dwelt so long upon this subject, if I had not been anxious to eradicate a prejudice so repugnant to the happiness of man. I have seen many victims sacrificed to this prejudice, especially among the female sex, who die daily through the terror of death. Such dreadful apprehensions seem peculiarly to affect those who, by nature or education, are endowed with superior sensibility; for the vulgar look forward to their dissolution, either with indifference, or, at least, without any degree of terror.

True philosophy views objects as they exist. Our internal feelings would uniformly accord with this philosophy, if they were not perverted by the illusions of imagination, and by the unfortunate habit of creating hypothetical phantoms of excessive pains, and of pleasures which exceed the limits of human nature. Objects are only terrible or ravishing at a distance; when we have the resolution or the wisdom to take a near inspection of them, every alarming and every alluring circumstance instantly disappear.

If this doctrine, concerning the gradual and generally insensible decay of the vital powers, required any farther support, no inconsiderable aid might be derived to it from the uncertainty of the signs of death. If we consult the writers on this subject, and particularly those of Winslow and Bruhier, we shall receive full conviction, that, between life and death, the shade is often so undistinguishable, as to elude all the powers of the medical art. They inform us, 'That the colour of the face, the 'heat of the body, the suppleness of the joints, are un-'certain marks of life; and that the paleness of the 'countenance, the coldness of the body, the rigidity of 'the extremities, the cessation of motion, and the aboli-'tion of the senses, are very equivocal signs of death.' The same remark may be made with regard to the apparent cessation of the pulse, and of respiration: these motions are often so slow, that they elude all our perceptions. A mirror or a candle is applied near the mouth of a sick man; if the mirror be sullied, or the flame vibrates, life is concluded not to be extinguished. But these effects are often produced, after death has actually taken place; and sometimes they appear not, though the patient be still alive. When we wish to be certain of the death of any person, we apply fumes of tobacco, and other irritating bodies, to the nostrils; we endeavour to excite the organs by violent agitations, by pricking or scarifying the hands and feet, by applying red hot

iron or wax to different parts of the body, by raising loud and unusual cries, &c. But instances have occurred where all these and similar trials have proved abortive; and yet, to the astonishment of the spectators, the person supposed to be dead has afterwards recovered the powers of life.

Hence nothing can be more apparent, than that a certain condition of life has a great resemblance to actual death. Both humanity and reason, therefore, require that we should be cautious of abandoning the body, and of committing it too hastily to the grave. Neither ten, twenty, nor twenty-four hours are sufficient to distinguish a real from an apparent death; since instances are not wanting of persons returning from the tomb at the end of two and of three days. Why should we precipitate the interment of those persons, the prolongation of whose lives we most ardently desire? Why should a practice subsist, in the abolition of which all men are equally interested? Are not the frequent abuses recorded by physicians sufficient to deter us from too hasty interments? Mr. Winslow informs us, 'That the body, 'though living, is sometimes so completely deprived of 'every vital function, that it has every external appear-'ance of death. But,' he remarks, 'both religion and 'charity require, that a reasonable time should be al-'lowed to discover whether any signs of life may not 'still manifest themselves, otherwise we become actual 'murderers, by burying people who are not dead. If 'we may credit the greatest number of authors, three 'days, or 72 hours, are sufficient for this purpose. If, 'during this period, no signs of life appear, but, on the 'contrary, the body begins to emit a cadaverous odour, 'which is an infallible mark of death, we may then bury 'it without scruple.'

We shall afterwards have an opportunity of mentioning the customs of different nations with regard to funerals, embalming, &c. The greatest part, even of the most savage people, pay more attention than we to their departed friends: what we esteem a ceremony only, they regard as a primary duty: they respect their dead; they clothe them; they speak to them; they recite their exploits; they praise their virtues: but we, who pretend to superior sensibility, fly from our dead, and inhumanly abandon them; we desire not to see them; we have neither the courage nor the inclination to speak of them; we even avoid such objects or situations as might recal the idea of them: we are, therefore, either more indifferent, or weaker than savages.

Having thus traced the history of life and death with regard to the individual, let us now consider both in relation to the whole species. Man dies at every age; and, though the duration of his life be longer than that of most animals, yet it is unquestionably more various and uncertain. Attempts have lately been made to ascertain these uncertainties, and, by observations, to fix some standard with regard to the mortality of mankind at different periods of life. If these observations were sufficiently numerous and exact, they would be of great utility in determining the number of people, their increase, the consumption of provisions, &c. Many authors have written with ability on this subject. M. de Parcieux, of the academy of sciences, has lately published an excellent work for regulating tontins and annuities. But, as his principal object was to calculate the mortality of annuitants, and as such persons are particularly pitched upon for their apparent strength of constitution, his calculations cannot be applied to mankind in general. For the same reason, his curious tables of the mortality of the different orders of religious must be confined to their proper objects. Hally, Grant, Kersboom, Simpson, &c. have also given tables of the mortality of the human species. But, as their observations have been limited to the bills of mortality in a few parishes of London, Breslau, and other large towns, they can afford little information as to the general mortality of mankind.

Many useful conclusions have been drawn by M. Dupré. From his tables it appears, that a new-born infant, or a child of 0 age, has an equal chance of living 8 years; that a child of 1 year will live 33 more; that a child of 2 years will live 38 more; that a man of 20 years will live 33 and 5 months more; and that a man of 30 years will live 28 more, &c.

It may be farther observed, 1. That 7 years is the age at which the longest duration of life is to be expected; for there is then an equal chance of surviving 42 years 3 months; 2. That, at 12 years, one fourth of life is expired, since we have no reason to hope for above 38 or 39 years more; 3. That, at 28 or 29 years, we have lived one half of our days, since there are only 28 more to be expected; and, lastly, That, at the age of 50, three fourths of life are gone, the remaining chance extending only to 16 or 17 years longer.

But these physical truths, however mortifying, may be alleviated by moral considerations. The first 15 years of our existence may be regarded as nothing: every thing that passes during this long period, is either obliterated from the memory, or has so little connection with the views and objects which afterwards occupy our attention, that it ceases entirely to be interesting. The train of our ideas, and even the nature of our existence, suffer a total change. We begin not to live, in a moral sense, till after we have learned to arrange our thoughts, to direct them towards futurity, to assume a kind of consistency of character similar to that state at which we are ultimately destined to arrive. Considering the duration of life in this point of view, which is the only real one, at the age of 25, we have passed one fourth of our days, at the age of 38, one half, and, at the age of 56, three fourths.

SECTION VI

Of the Sense of Seeing.

WE have already described the parts of which the human body consists; and shall now proceed to examine those curious organs by which sensations are conveyed to the mind. In this investigation we shall endeavour to point out the uses of the different senses, and to mark those errors to which we are, in some measure, subjected by nature.

In the human fœtus the eyes are early formed; in the chicken also, they are the first double organs which make their appearance; and in the eggs of lizards, and of several species of birds, I have remarked that the eyes were more prominent and advanced in growth than any other double parts of the body. In viviparous animals, it is true, and particularly in the human fœtus, the eyes are not so large, in proportion, as in the oviparous; but still they are more quickly expanded than the other parts of the system. The same remark applies to the organ of hearing. The small bones of the ear are fully formed before the other bones of the body have acquired any degree of solidity or bulk. In the seventh month the whole bones of the ear are perfectly solid, and have acquired all the density they possess in the adult state. It is, therefore, apparent, that those parts which are furnished with the greatest quantity of nerves, are first formed and expanded. We formerly remarked that the vesicles which contain the brain and cerebellum, and that which contains the spinal marrow, appear first. The spinal marrow is a fundamental and essential part of the body, and is therefore first formed. Hence the nerves exist before any of the other parts of the body, and those organs which are most amply supplied with them, as the ears and eyes, are most quickly expanded.

Upon examining the eyes of an infant some hours after birth, it is easy to perceive that it can make no use of them: this organ not having acquired a sufficient degree of consistence, the rays of light make a confused impression only on the retina. About a month after birth the eye seems to have acquired that tension and solidity which are necessary for the proper transmission of the rays of light; but, even then, infants are incapable of fixing their eyes upon any object; they roll and move them to all sides without being able to distinguish the objects to which their eyes are directed. In six or seven weeks, however, they begin to fix their attention upon luminous objects. But this exercise tends only to fortify the eye, without conveying any exact perception of different objects; for the first great error in vision is the inverted representation of objects upon the retina: and, till children learn the real position of bodies by the sense of feeling, they see every object inverted. A second error in the vision of infants arises from the double appearance of objects; because a distinct image of the same object is formed on the retina of each eye. It is by the experience of feeling bodies only, that children are enabled to correct this error. By the frequent handling of objects, they gradually learn that they are neither double nor inverted; and custom soon makes them imagine they see objects in the order and position in which they are represented to the mind by the sense of touching. Hence, if we were deprived of feeling, our eyes would deceive us both with regard to the position and number of objects.

The inversion of objects is a result of the structure of the eye; for the rays which form the images of these objects cannot enter the pupil without crossing each other. This admits of an easy proof: when light is transmitted through a small hole into a dark chamber, the images of the objects from without are represented on the wall in an inverted position; because all the rays reflected from the different points of the object cannot pass through this small hole, in the same extent and position as they proceed from the object, unless the hole be of equal dimensions with the object. But as every part of the object reflects images of itself on all sides, and as the rays which form these images proceed from every point of the object as from so many centres, none of them can pass through the hole but those that arrive at it in different directions. Hence the hole becomes the centre of the whole object, at which the rays flowing from the lower, as well as the higher parts of the object, arrive in converging directions; and, of course, they must cross each other at this centre, and represent the picture of the object on the opposite wall in an inverted position.

It is equally easy to show that we see all objects double: if, for instance, we look at an object with the right eye, we will find that it corresponds with a certain point of the wall; if we look at the same object with the left, it then corresponds with a different point; and, lastly, when we look at it with both eyes, it appears

in the middle between these points. Thus an image of the object is formed on both eyes, one of which appears on the left, and the other on the right; and we perceive it to be single and in a middle situation, because we have learned to correct this error of vision by the sense of touching. In the same manner, if we look with both eyes at two objects, nearly in the same direction, by fixing our eyes on the nearest, we perceive it to be single; but the farthest appears to be double; and if we fix our eyes on the farthest, it appears to be single, while the nearest is perceived to be double. This is an evident proof that we see all objects double, though we conceive them to be single; and that, though we form an accurate idea of their real situation, yet we actually see them where they are not. If, therefore, the sense of seeing were not constantly rectified by that of touching we would be perpetually deceived as to the position, number, and situation of objects; we would perceive them to be inverted, double, and to the right or left of their real situations; and, instead of two, if we had 100 eyes, we would still conceive objects to be single though they were in reality multiplied a hundred fold.

Thus a separate image of every object is formed in each eye; and, when the two images fall on corresponding parts of the retina, or those parts which are always affected at the same time, objects appear single, because we are accustomed to judge of them in this manner. But when the images of objects fall upon parts of the retina which are not usually affected at the same time, they then appear double, because we have not acquired the habit of rectifying this unusual sensation.

M. Chesselden, in his anatomy, relates the case of a man who had been affected with a strabismus, in consequence of a blow on the head. This man saw every object double for a long time. But he gradually learned to correct this error of vision with regard to objects which were most familiar to him; and at last he saw every object single as formerly, though the squinting of his eyes were never removed. This is a proof still more direct that we really see all objects double, and that it is by habit alone we learn to conceive them to be single. If it should be asked, why children sooner acquire the faculty of correcting this deception than adults whose eyes have been distorted by accident? It may be replied, that children, having acquired no opposite habits, less time is, of course, necessary to correct the errors of their sensations; but that adults, who have for many years been accustomed to perceive objects single, because their images fall upon corresponding parts of the retina, have a contrary habit to oppose, and, consequently, must require a long time before they can obviate its effects.

The sense of seeing conveys no idea of distances. Without the aid of touching all objects would appear to be within the eye, because it is there alone that their images exist: and an infant, who has had no experience of the sense of touching, must consider all external bodies as existing in itself; they appear larger or smaller only according as they approach or recede from the eye. A fly, when near the eye, will seem larger than an ox or a horse at a distance. Thus an infant can have no idea of the relative magnitude of objects, because he has no notion of the different distances at which he views them. It is only after measuring space by the extension of the hand, or by transporting their bodies from one place to another, that children acquire correct ideas concerning the distances and magnitudes of objects. Before this period they can form no judgment of the distance or magnitude of an object, but by the image painted on the retina. Their ideas of magnitude entirely result from the angle formed by the extreme rays reflected from the superior and inferior parts of the object: of course every near object must appear to be large, and every distant object small. But, after having acquired, by touch, ideas of distances, the judgment concerning magnitude begins to be rectified: they trust not alone to the apparent magnitude conveyed by the eye: they endeavour to investigate the distance; they try, at the same time, to distinguish the object by its form; and then they judge of its magnitude.

If we judge by the eye alone, and have not acquired the habit of apprehending the same objects to be equally large, though viewed at different distances, the first soldiers in a file of 20, must appear much larger than the last. But we know the last soldier to be equally large with the first; and hence we judge him to be of the same dimensions. And, as we have the habit of considering the same object to be of equal magnitude at all ordinary distances, we are never deceived on this head, except when the distance is too great, or when the interval is in an uncommon direction. A distance ceases to be familiar to us whenever it is too large, or rather when the interval is vertical instead of horizontal. The first ideas of the comparative magnitude of objects we acquire either by measuring their relative distances by the hand, or by moving the whole body. But all the experiments by which we commonly rectify the errors of vision, with regard to distances, are made horizontally. We have no acquired habit of judging of the magnitude of objects which are elevated above, or sunk below us; because we are not accustomed to measure in this direction by the touch. Hence, when viewing men from the top of a tower, or when looking up to a cock or a globe on the top of a steeple, we think these objects are much more diminished than if we viewed them at equal distances in a horizontal direction.

Though a small degree of reflection be sufficient to convince us of the truth of these positions, it may still

be of use to relate the facts which confirm them. The celebrated Chesselden couched cataracts in both eyes of a youth of 13 years of age, who had been blind from his birth. The operation succeeded; and Mr. Chesselden carefully observed the manner in which the young man was affected by the sense of seeing. These observations he published in the Philosophical Transactions. This young man was not absolutely blind: like other persons affected with cataracts, he could distinguish night from day, and even black from white; but he had not the most distant conception of the figure of bodies. The operation was first performed in one eye. When he saw for the first time, he was so far from judging of distances that he believed every object touched his eyes in the same manner as every thing he handled touched his skin. Objects of a regular figure, and having plain surfaces, were most agreeable to him, though he was still incapable of forming any judgment as to their form, or telling why they afforded him more pleasure than others. His ideas of colours before the operation were so faint, that, after receiving his sight, he was unable to distinguish one from another. He insisted that the colours which he then saw were not the same he was formerly acquainted with. He knew not the figure of any object; nor could he distinguish one from another, however different in form and in magnitude. When presented with things which were formerly familiar to him, he observed them with attention, that he might be able to know them afterwards. But, as he had too many objects to recognize at once, he forgot the greatest part of them; and, from his commencing to distinguish objects, he did not retain in his memory one out of a thousand. Those objects and persons which were formerly most beloved by him, he was astonished to find that they were not also the most agreeable to his sight. It was more than two months before he could perceive that pictures were the representations of solid bodies. Previous to this period he considered them only as plain surfaces diversified by different colours. But after he began to perceive that pictures represented solid bodies, he expected to recognize their seeming inequalities by touching the canvas; and was perfectly astonished when he found the whole uniformly smooth. He asked, whether the deception arose from the sense of feeling or that of seeing? he was then shewn a miniature portrait of his father, contained in his mother's watch-case. He recognized the resemblance of his father: but he inquired with amazement how so large a countenance could possibly be contained in so small a compass; for it appeared to him equally strange, as that a bushel should be held in a pint vessel. At first his eye could support a small quantity of light only; and every object seemed much larger than the life. But after he had seen objects of large dimensions, former objects appeared to be proportionally diminished. He had no conception that any object exceeded the limits of those he had already seen. He knew that his own apartment was only a part of the house, and yet he was unable to comprehend how the house should be larger than his chamber. Before the operation he expected not much pleasure from the acquisition of the new sense that had been promised him, except what should arise from his being enabled to read and write. He alledged, for example, that he could receive no new satisfaction from walking in the garden, because he already knew every corner of it, and could walk there with great ease and freedom. He had even remarked that his blindness gave him the advantage of walking in the night with more confidence and security than those who enjoyed the benefit of sight. But after he began to have the proper use of this new sense, he was transported beyond measure. He declared that every new object afforded a fresh delight; and that the pleasure he felt exceeded the powers of expression. About twelve months after the operation he was conducted to Epsom, from which there is a beautiful and extensive prospect. He was charmed with the view; and he called this landscape a new mode of seeing.

About a year after the first operation, the cataract on the other eye was couched with equal success. With this second eye he perceived objects to be much larger than with the other, but not so large as when he first received sight; and when he viewed the same object with both eyes, he said that it appeared to be twice as large as with the first eye alone. But after he procured the use of both eyes he did not see objects double, or, at least, Mr. Chesselden could not be certain that he did.

Mr. Chesselden records several other examples of blind men, who had no remembrance of light, restored to vision by the same operation; and he assures us, that, when they first obtained the use of their eyes, they expressed their perceptions in a similar manner, though not so minutely: and he remarks upon the whole, that as, during their blindness, they had no occasion to move their eyes, it cost them much difficulty and a considerable time before they could acquire the faculty of directing them to the objects they wished to examine.

As, from particular circumstances, we can have no just idea of distance, and, as we cannot judge concerning the magnitude of objects, but by the largeness of the angle or image formed in the eye, we must necessarily be subject to deceptions with regard to these articles. Every body knows how liable we are, when travelling in the night, to mistake a bush that is near us for a tree at a distance, or a distant tree for a bush which is at hand. In the same manner, if we are unacquainted with the figure of objects, we cannot form any idea either of their distance or magnitude: a fly passing with rapidity at some inches from the eye, would, in this case, appear like a bird at a considerable distance; and a horse

standing in the middle of a plain, would not seem larger than a sheep. But, as soon as we knew it to be a horse it would instantly appear as large as the life, because we have the power of correcting this deception of vision.

Whenever, therefore, we are benighted in a part of the country with which we are unacquainted, being unable, on account of the darkness, to judge of the distance or figure of objects, we are every moment liable to all the deceptions of vision. This is the source of that dread which most people feel in the dark, and of those spectres and terrible figures which so many persons tell us they have seen in the night. Though such figures, it is commonly asserted, exist in the imagination only; yet they may have a real existence in the eye; for whenever we have no other mode of judging of an unknown object but by the angle it forms in the eye, its magnitude will uniformly increase in proportion to its propinquity. If it appears, when at the distance of 20 or 30 paces, to be only a few feet high, its height, when within two or three feet of the eye, will be many fathoms. An object of this kind must naturally excite terror and astonishment in the spectator, till he approaches and recognizes it by actual feeling; for the moment a man knows an object, the gigantic appearance it assumed in the eye instantly diminishes, and its apparent magnitude is reduced to its real dimensions. But if, instead of approaching such an object, the spectator flies from it, he can have no other idea of it but from the image which it formed in his eye; and, in this case, he may affirm with truth, that he saw an object terrible in its aspect, and enormous in its size. Thus the notions concerning spectres is founded in nature, and depend not, as some philosophers affirm, upon the imagination alone.

When we are unable to form an idea of the distance of objects by the knowledge of the space between them and the eye, we endeavour to judge of their magnitude by distinguishing their figures. But, when the figures are not distinguishable, and when we view a number of objects of the same form, we conceive those that are most brilliant to be nearest, and those which are most obscure to be at the greatest distance. This mode of judging gives rise to deceptions of a singular nature. When a multitude of objects are disposed in a right line, as the lamps on the road from Versailles to Paris, of the proximity or remoteness of which we can only judge by the different quantities of light they transmit to the eye, it frequently happens, when viewed at the distance of an eighth of a league, that the lamps appear to be on the right hand, in place of the left. This deception is an effect of the cause above mentioned; for, as the spectator has no other criterion to judge of the distance of the lamps, but the quantity of light they emit, he thinks the most brilliant of them is nearest to his eye. Now if the first two or three lamps should happen to be most obscure, or, if one in the whole range was more brilliant than the rest, that one, to a spectator, would seem to be the first, and all the others, whatever might be their real situation, would seem to be placed behind it. This apparent transposition could not be effected by any other means than a change of situation from left to right; for, in a long range of objects, we cannot apprehend what is really behind to be situated before any one of these objects, without seeing on the right what is on the left, or on the left what is on the right.

I have thus mentioned the principal defects of the sense of seeing; and shall now proceed to examine the nature, properties, and extent of that admirable organ, by which we are enabled to have a communication with the most distant objects. Sight is a species of touching, but very different from the common species of that sense. Before we can touch any object, we must either approach it with some part of our body, or it must approach us. But, with the eye, we can touch any object, however distant, if it transmits a sufficient quantity of light to make an impression on, or if its picture forms a sensible angle in, the eye. The smallest visible angle is about one minute. This angle, when an object is viewed at the greatest distance of vision, is about the 3436th part of the diameter of that object. An object, for example, of a foot square, ceases to be visible at the distance of 3436 feet. A man of five feet high is not visible beyond the distance of 17,180 feet, when the sun shines.

But, with regard to the extent of human vision, an observation occurs, which seems to have escaped all the writers on optics: the extent of our sight diminishes or augments in proportion to the quantity of light that surrounds us, supposing the illumination of the object to remain the same. If the same object which we see during the day at the distance of 3436 times its diameter, were equally illuminated during the night, it would be visible at a distance 100 times greater. A candle is visible in the night at the distance of more than two leagues; that is, supposing the diameter of the luminary to be one inch, it would be visible at the distance of 316,800 times the length of its diameter. But, in the day, this candle would not be discernible beyond ten or twelve thousand times the length of its diameter. The same remark is applicable to all objects, when viewed during the day or the night. We may, therefore, conclude, that the extent of our vision is much greater than our first supposition; and that the reason why we are often unable to distinguish distant objects, is less owing to a defect of light, or to the smallness of the angle under which they are painted in the eye, than to the profusion of rays reflected from intermediate objects, which, by their brilliancy, prevent us from perceiving the fainter and more diverging rays that proceed from

distant objects. The retina of the eye is like a canvas upon which objects are painted. The colour of those pictures are bright or obsure, in proportion to the distances of the objects represented. When objects are very remote, their pictures on the retina are so faint, that they are entirely obliterated by the vigorous and lively impressions made by nearer objects, with which we are every where environed. But, when the intermediate objects emit a feeble light only, compared with that which proceeds from remote objects, as, for example, when we view a luminous body in the nighttime, when the distant object makes a distinct picture on the retina, and becomes perfectly visible. It is a consequence of these facts, that a man, by placing himself in the dark, and employing a long tube, may make a telescope, which will have a considerable effect even during the day. For the same reason, a man at the bottom of a deep pit can see the stars at noon; and this fact was not unknown to the ancients, as appears from the following passage of Aristotle: 'Manu enim admota, 'aut per fistulam, longius cernet. Quidam ex foveis 'puteisque interdum stellas conspiciunt.'

We may therefore affirm, that the human eye is capable of being affected with objects which subtend not an angle above a second, or less, even when they reflect no more light than when they were seen under an angle of one minute; and consequently that the powers of this organ are greater than was formerly imagined. But if objects, without forming a greater angle, were furnished with a more intense light, we would see them at still greater distances. A small taper, when vivid, is seen much farther than a flambeau that emits a dim light. In order to determine the utmost distance at which an object can be rendered visible, three things must be considered: 1. The largeness of the angle formed in the eye; 2. The degree of light with which the neighbouring and intermediate objects are illuminated; and 3. The intensity of the light proceeding from the object itself. Vision is affected by each of these causes; and it is only by estimating and comparing them, that we can determine the distance at which any particular object can be discerned. The following is a demonstrative proof of the influence of intensity of light upon vision. Telescopes and microscopes are known to be instruments of the same kind, each of them increasing the visible angle of objects, whether they be really minute, or appear so on account of their distance. Why then do telescopes with difficulty magnify objects a thousand times, when a good microscope magnifies more than a million? This difference, it is apparent, proceeds from the degree of light only; for, if we could illuminate distant objects with an additional quantity of rays, they would appear infinitely clearer, though seen under the same angle; and telescopes would have the same effect upon distant objects as microscopes have upon those which are minute. But this is not a proper place for expatiating on these subjects.

The distance at which any object can be seen is seldom the same in both eyes. There are few men who have both eyes equally strong. When this inequality is great, the strongest eye is most generally employed, which is the cause of squinting, as I have elsewhere proved. When both eyes are equally strong, and directed to the same object, one should imagine that the vision would be doubly distinct; but the difference has been found by experiment to be only one 13th part; and this phænomenon may admit of the following solution. The two optic nerves, near the place where they come out of the skull, unite, and then separate by an obtuse angle, before they enter the eyes. The motion communicated to these nerves by the impression of objects on the retina, cannot be transmitted to the brain without passing the united part. Hence these two motions must be combined, and produce a similar effect, as when two bodies moving upon two sides of a square, and impinging on a third, make it move in the diagonal. Now, if the angle were about 115 or 116 degrees, the diagonal would be to the side as 13 to 12, which is the same ratio that the sensation resulting from both eyes bears to that which results from one. The angle formed by the two optic nerves being nearly equal to that supposed above, the loss of sensation may be attributed to this position of the nerves; and this loss will always increase in proportion to the greatness of the angle.

Short-sighted persons are generally supposed to see objects larger than other men: but the reverse is the truth; for they actually see them diminished. I myself am short-sighted, and my left eye is stronger than my right. I have a thousand times examined the same objects, as the letters of a book, at the same distance, first with the one eye, and then with the other, and uniformly found that objects appeared both clearest and and largest to the left eye; and, when I distorted one of my eyes to make an object appear double, the image presented to the right eye was less than the other. I cannot, therefore, hesitate in pronouncing, that the more short-sighted any man is, he sees objects proportionally diminished. I examined several persons who had eyes unequal in strength, and all of them declared that they saw objects larger with the strong than with the weak eye. This phænomenon is perhaps the effect of habit; for short-sighted people, being accustomed to approach close to objects, and to view a small portion of them only at a time, their eyes acquire a standard of magnitude much less than other men, who can take in at once all the parts of large bodies.

Short-sightedness has been often ascribed to a roundness or prominence of the eyes. But this cause is not satisfactory; for some have suddenly become short-sighted, as the young man mentioned by Mr. Smith in

his optics, who became short-sighted on coming out of a cold bath, and who, from that period, was always obliged to use a concave glass. It cannot be supposed that the crystalline and vitreous humours were all at once inflated to such a degree as to produce this difference in vision. Short-sightedness may as well proceed from the respective position of the different parts of the eye, and especially of the retina, as from the form of the humours; it may proceed from a less degree of sensibility in the retina, from a smallness of the pupil, &c. In the two latter cases, it is true, concave glasses would be useless, and even hurtful; in the two former, they may be employed with advantage. But still, objects seen through these glasses are neither so distinct, nor perceived at such a distance, as other men see them with the naked eye; because short-sighted persons, as formerly remarked, see the pictures in a diminished form, and concave glasses diminish them still farther: whenever, therefore, these pictures become so small as to make too faint an impression on the retina, they cease to be visible; consequently, people who labour under this defect, see not so far with the assistance of glasses as other men do with their eyes.

As the eyes of infants are less than those of adults, they must likewise see objects less; because the greatest angle which an object can form in the eye must always be proportioned to the dimensions of the retina: if the field of the retina, where the pictures of objects are formed, be supposed to be half an inch in adults, it will not exceed a third or a fourth of an inch in infants. Children, of course, cannot see so far as adults; for, as objects appear less to them, they must sooner become invisible. But as in infants the pupils are larger, in proportion to the size of their eyes, than those of adults, they may derive some small advantage from this circumstance.

Old men, as the humours of their eyes are said to be dried up, ought to see nearer than young men: but the reverse is true; for old men see best at a distance. This alteration cannot proceed entirely from a diminution, or a flattening of the humours of the eye, but rather from a change of position betwen its parts, as between the cornea and the crystalline, or between the vitreous humour and the retina. This may be easily understood by supposing that the cornea becomes more solid as we advance in years, and consequently, that it cannot readily assume that convexity which is necessary in order to see near objects; and, as it must be flattened by drying, this circumstance alone is sufficient to make old men see best at a distance.

Clear and distinct vision, though different in their nature, are terms very generally confounded by writers on optics. We see an object clearly, whenever it is sufficiently illuminated to enable us to form a general idea of its figure; but we see it not distinctly, till it be so near that we can examine all its parts. When we view a distant tower, we see it clearly as soon as we perceive it to be a tower; but we see it not distinctly, till we approach so near as to be able to determine not only its general dimensions, but to distinguish the parts of which it is composed, as the order of architecture, the materials, the windows, &c. We may, therefore, see an object clearly without seeing it distinctly, and we may see it distinctly without seeing it clearly; because distinct vision implies a successive examination of the different parts of objects. Old men see clearly, but not distinctly: they perceive large or luminous objects at a distance; but they are unable to distinguish small objects, as the characters of a book, without the assistance of magnifying glasses. Short-sighted persons, on the contrary, see small objects distinctly; but they have no clear vision of large objects, unless they are diminished by concave glasses. A great quantity of light is necessary for clear vision, and a small quantity is sufficient for distinct vision. Hence short-sighted people see better in the night than other men.

When an object is too brilliant, or when the eye fixes too long upon the same object, the organ is injured or fatigued, vision becomes indistinct, and the image of the object, having made an impression too violent, or remained too long on the retina, seems, for some time, to be painted on every body we look at. But I will not enlarge on this subject, because I have elsewhere given a full explication of it. I shall only observe, that nothing perhaps is more destructive to the eye than too great a quantity of light. Blindness is exceedingly frequent in the northern regions, where the snow, illuminated by the rays of the sun, obliges travellers to cover their eyes with crape, to prevent the dangerous, and often sudden, effects of too much light. In the sandy deserts of Arabia, the reflection of the light is so violent, that the eyes are unable to support it. Such persons, therefore, as are obliged to write or read long at a time, should beware of using a strong light.

SECTION VII.

Of the Sense of Hearing.

THE sense of hearing, like that of seeing, conveys perceptions of distant objects; it is, of course, subject to similar errors, and must deceive us, when we have no opportunity of rectifying, by the touch, the ideas it excites. The sense of hearing communicates no distinct intelligence of the distance of sonorous bodies. A great noise at a distance, and a small one when near, produce the same sensation; and, unless we derive aid from the other senses, we cannot distinguish the distance of the one from that of the other.

When we hear an unknown sound, we can neither judge of the distance, nor of the momentum of the stroke which gives rise to it. But, whenever we can ascertain the species of any individual sound, we are able to guess both at the distance and momentum of the stroke. If, for example, we hear the report of a cannon, or the sound of a bell, we compare them with those of the same kind which we have formerly heard, and form a gross judgment both of their distance and momentum.

Every body that impinges on another produces sound: this sound, in non-elastic bodies, is simple, but multiplied in those which are elastic. When we strike a bell, a single stroke produces a sound, which is successively repeated as long as the sonorous body continues to vibrate. If, therefore, we had not acquired the habit of judging every sound to be single which is produced by one stroke, we would conceive all sounds to be multiplied. On this subject, I shall relate an incident that happened to myself. When lying in bed half asleep, my clock struck, and I counted five strokes of the hammer on the bell, which I heard distinctly. I immediately rose, and, upon examination, found, that it was only one o'clock, and that one stroke only had been struck on the bell; for there was not the smallest derangement in the machinery. After a little reflection, I concluded, that, if we knew not from experience that a single stroke should produce but one sound, every vibration of a bell would be heard as a separate sound, and as if several strokes had successively been repeated on the sonorous body. When I heard the clock strike, I was in the same situation with a person who had heard for the first time, and who, having no idea of the manner in which sound is produced, would judge only by the impression made on the ear; and, on this supposition, he would hear as many distinct sounds as there were successive vibrations.

It is the number of vibrations excited in elastic bodies which constitutes the tone of sound. There is no tone in a simple sound. The report of a gun, or the crack of a whip, produce different sounds; but they have no tone. It is the same with every instantaneous sound. Tone consists in the duration of the same sound for a certain time. This duration of sound may be effected in two different ways: the first, and most common, is the succession of vibrations in elastic and sonorous bodies. But the same effect may be produced in non-elastic bodies by a quick repetition of strokes; for a succession of vibrations acts upon the ear in the same manner as if each vibration were a separate stroke.

By considering, in this view, the production of sound, and the different tones which modify it, we shall find, that a repetition of equal strokes is necessary to produce a tone from bodies incapable of vibration. If the number of equal strokes be augmented in the same time, the tone will only be rendered more equal and perceptible, without changing either the sound or the tone produced by the strokes. But if the force of the equal strokes be augmented, the sound will be stronger, and the tone may be changed. For example, if the force of the stroke be doubled, it will produce a sound doubly strong; and if the tone of the former was an octave, that of the latter will be doubly grave.

May not elastic bodies, when set a vibrating by a single stroke, be regarded as bodies whose figure and length precisely determine the force of the stroke, and limit it to the production of a certain sound only? If one stroke on a bell have only half the force of another, it will not be heard at so great a distance, but it will still produce the same tone. It is the same with the string of an instrument; the same length gives always the same tone. Should not this lead us to think, that, in the explication of the production of different tones by the greater or smaller number of vibrations alone, we mistake the effect for the cause? for the vibrations of sonorous bodies being nothing else than what is produced in non-elastic bodies by a frequent repetition of equal strokes, a greater or lesser number of vibrations should have no more influence, with regard to tones, than the quicker or slower repetition of strokes made

upon bodies which do not vibrate. Now, this quicker or slower repetition of strokes produces no change; neither ought the frequency of vibrations; and the tone, which, in the first case, depends upon the force of the stroke, depends, in the second case, upon the volume of the sonorous body. If it be double the thickness, and of the same length, or double the length, and of the same thickness, the gravity of the tone will be double, in the same manner as the tone of a non-elastic body is doubly grave, when struck with a double weight or force.

If we strike a body incapable of vibrating, with a double force, or a double mass of matter, it will produce a sound doubly grave, or an octave lower; for it is the same thing as if we struck with two equal masses instead of one of them, which would necessarily double the intensity of the sound. Suppose, then, that two non-elastic bodies are struck, the one with a single mass, the other with two, each of them equal to the first; a sound would be produced by the first body, whose intensity would be only one half of that produced by the second. But if we strike one of these bodies with two masses, and the other with three; in this case, the first body would produce a sound, the intensity of which would be one third less than that produced by the second. In the same manner, if we strike the one body with three equal masses, and the other with four, the former will produce a sound, the intensity of which will be one-fourth less than that produced by the latter. Now, in comparing numbers, we comprehend them most easily in the proportions of one to two, one to three, one to four, &c.; and, of all the proportions comprehended between the single and the double, those which we perceive with the greatest facility, are two to one, three to two, four to three, &c. Thus, in judging of sounds, the octave corresponds best with the original sound, then the fifth, and then the fourth; because these sounds are in the above proportion. For, if we suppose the small bones of the ear to be hard unelastic bodies, which receive strokes of equal masses of matter, we would more easily refer the sound produced by one of them to a certain standard, if the other sounds were produced by masses that were proportioned to the first, as 1 to 2, 2 to 3, or 3 to 4; because these are the proportions which the mind recognizes with the greatest facility. Thus, in considering sound as a sensation, the pleasure arising from harmony appears to consist in the proportion between the fundamental sound and the others by which it is succeeded. If these other sounds measure exactly the fundamental sound, they will be always harmonious and agreeable; but, if they are incommensurable, they will be harsh and discordant.

It may be asked, why should one proportion, when it is exact, be more agreeable than another, which is less exact? I answer, that the cause of pleasure originates from this justness of proportion; for, whenever our senses are acted upon in this manner, an agreeable sensation is the result; and disproportion, on the contrary, is always disagreeable. We may recollect what was said concerning the blind man who received his sight from the dexterity of Mr. Chesselden. When he began to see, regular objects were more agreeable to him than those which were rough and irregular. It is, therefore, unquestionable, that the idea of beauty, and the pleasing sensations we receive by the eye, originate from regularity and proportion. It is the same with the sense of touching: smooth, round, and uniform bodies, afford us more pleasure than those which are rough and unequal. Thus the pleasure arising from the sense of touching, as well as from that of seeing, is founded in the proportion of objects. Why, therefore, should not the pleasures of the ear proceed from the proportion of sounds?

Sound, like light, is not only propagated at a distance, but is capable of being reflected. The laws which regulate the reflection of sound are not indeed so well understood. All we know is, that sound is reflected when its motion is interrupted by hard bodies: a mountain, a house, a wall, reflect sound, and sometimes so perfectly, that we imagine it proceeds from a direction opposite to that of its original motion. Smooth concave surfaces, as vaults, hollow rocks, &c. produce the most distinct echoes. The internal cavity of the ear is fitted for reflecting sound in the most perfect manner. It is hollowed out of the hard part of the temporal bone, like a cavern in a rock. In this cavity sounds are repeated and articulated; this repetition of sound excites vibrations in the solid parts of the lamina of the cochlea, which are communicated to the membranous part of the lamina; and this membranous part is an expansion of the auditory nerve, which conveys these different vibrations to the mind. As the osseous parts are solid and insensible, they can receive and reflect sounds only; the nerves alone are capable of producing sensation. Now, in the organ of hearing, the only nervous part is a portion of the spiral lamina; all the rest is solid; and hence I have made this part the immediate organ of hearing, which may be farther proved by the following reflections.

The external ear is only an accessory to the internal. Its concave windings may augment the quantity of sound; but we can hear very well without the external ears, as appears from dogs and other animals, which have had these organs cut off. The membrane of the tympanum is not more essential to the perception of sound than the external ear; for many persons have heard distinctly after this membrane was either entirely or partly destroyed. Some persons can make the smoke of tobacco, silk cords, lead plates, &c. pass from the mouth to the ear, and yet they hear as well as other

men. Neither do the small bones of the ear seem to be essential to hearing. It has frequently happened, that these bones have been carious, and have even come out of the ear, without destroying the sense of hearing. Besides, birds have no such bones; and yet they have most delicate ears. The semicircular canals appear to be more necessary. They are a kind of winding tubes in the os petrosum, that seem to direct and conduct the sonorous particles to the membranous part of the cochlea, upon which sound acts, and the sensation of it is produced.

Deafness is incident to old age; because the density of the membranous part of the lamina of the cochlea augments in proportion as we advance in years. When this part becomes too solid, the person grows dull of hearing; and when it is entirely ossified, deafness is the consequence; because there is no longer any sensible part of the organ capable to transmit the sensation of sound to the mind. A deafness proceeding from this cause is incurable. But when it proceeds from a stuffing of the auditory canal with wax, or other viscid matter, it may be removed by syringing, or even by instruments. We may easily ascertain whether deafness be occasioned by any external or internal cause, by puting a repeating watch into the person's mouth. If he hears it strike, he may be assured that his deafness is effected by an external cause, and that it in some measure admits of a remedy.

I have often remarked, that men who have unmusical ears, and bad voices, hear better with the one ear than with the other. I formerly observed, that squinting was occasioned by an inequality of strength in the eyes: a person who squints sees not so far with the distorted eye as with the other. From this analogy I was led to make some experiments on men who sung falsely; and I uniformly found that they heard better with the one ear than with the other. Through each ear they receive a different sensation, which produces a discordance in the total result; and thus, by always hearing false, they necessarily sing false, without perceiving any defect. Persons of this kind are likewise often deceived as to the quarter from which a sound comes. If their best ear be the right one, sounds will more frequently seem to proceed from the right than from the left. I speak here of such persons only as are born with this imperfection; for, though a man advanced in life may by accident have one ear duller than another; yet, as he was formerly in the habit of receiving just perceptions of sound, neither his ear nor his voice will be affected by the change.

Trumpets or funnels employed to assist the hearing, answer the same end as convex glasses to old or decayed eyes. The parts necessary to hearing, as well as those necessary to vision, become blunt and insensible with age; and therefore each of them equally requires the assistance of art to augment the quantity of the medium through which their peculiar sensations are transmitted. Trumpets for facilitating hearing might be rendered as extensively useful to the ear, as telescopes are to the eye; but these trumpets could not be employed with advantage except in solitary and silent places; for neighbouring sounds are uniformly collected and blended with those at a distance, and produce in the ear nothing but a confused noise.

The sense of hearing is of more importance to man than to any other animal. In the latter, it is only a passive quality of receiving impressions from distant objects; but in man it is not only a passive quality, but becomes active by the use of speech. It is by this sense that we are enabled to carry on the business of society, and to form a mutual communication of our sentiments. The organs of the voice would be entirely useless, if they were not excited to motion by the sense of hearing. A man deaf from his birth is necessarily dumb, and has no idea of abstract and general knowledge. We must not omit, in this place, a singular account of a man who, for the first time, suddenly acquired the use of hearing, when he was at the age of 24 years. His history, of which the following is an abridgement, is recorded in the Memoirs of the French Academy.

'A young man, of the town of Chartres, aged about
'24, who had been deaf from his birth, began all at
'once to speak, to the utter astonishment of all who
'knew him. He informed his friends, that for three or
'four months before, he had heard the sound of bells;
'and that he was extremely surprised at this new and
'unknown sensation. Some time after a kind of hu-
'mour issued from his left ear, and then he heard dis-
'tinctly with both. During these three or four months
'he listened to every thing; and, without attempting to
'speak aloud, he accustomed himself to utter softly the
'words spoken by others. He laboured hard in acquiring
'the pronunciation of words, and in learning the ideas
'annexed to them. At length, thinking himself qualified
'to break silence, he declared that he could speak,
'though still imperfectly. Soon after he was interro
'gated by some able divines concerning his former con-
'dition. The principal questions turned upon God, the
'soul, and moral good and evil. But of these subjects
'he seemed not to have the smallest conception. Though
'he was born of Catholic parents, attended mass, was
'instructed to make the sign of the cross, and to assume
'all the external marks of devotion, he comprehended
'nothing of their real intention. He had formed no
'distinct idea of death; and existed purely in an animal
'state. Wholly occupied with sensible objects, and
'with the few ideas he had acquired by the eye, he drew
'no conclusions from them. He did not want parts;
'but the understanding of a man, when deprived of the

'intercourse of society, has so little exercise or culti-
'vation, that he never thinks but when sensible objects
'obtrude themselves on his mind. The great source of
'human ideas arises from the reciprocal intercourse of
'society.'

It is possible, however, to communicate ideas to deaf men, and to give them precise notions of general truths, by writing and by signs. A man deaf from his birth may be taught to read, to write, to communicate even the most complicated ideas, and to understand words by the motions of the lips. Nothing can be a stronger proof of the great resemblance between the different senses, and how far one may supply the place of another.

On this subject, it may not be improper to relate a fact, of which I was an eye-witness. M. Rodrigue Pereire, a native of Portugal, having long studied the most effectual methods of teaching the use of language to the deaf and dumb, brought a young man to my house, aged about 19, who had been deaf from his birth. M. Pereire undertook to learn him to speak, read, &c. At the end of four months, the young man could pronounce syllables and words; and, after ten months, he knew and could pronouce about 1300 words. His education, so happily commenced, was interrupted, for nine months, by the absence of his master, who then found that the young man had forgot a great part of what he had formerly learned. His pronunciation was extremely bad, and most of his words had escaped his memory. M. Pereire renewed his instructions in the month of February, 1748, and from that time has never left him, (June, 1749). This young man was presented before one of the meetings of the French Academy, where several questions were put to him in writing. His replies, which he made both in writing and in words, were extremely distinct. But his pronunciation was slow, and the tone of his voice was harsh. These defects, however, were unavoidable: for it is by imitation alone that we bring our organs gradually to form precise and well articulated sounds: but a deaf man cannot imitate what he does not hear. The shortness of the time employed by the master, and the surprising progress of the pupil, who was not deficient in ability, fully evince that persons born deaf and dumb may, by the assistance of art, be taught to hold intercourse with society; for I am persuaded, that if this man had begun to be instructed at the age of seven or eight, he would have attained as many ideas as mankind generally possess. [This conjecture is now fully verified by the labours of the ingenious Mr. Braidwood, of Edinburgh, who has, for many years taught, in his academy, great numbers of pupils, who had been born deaf, to speak, to read, to converse by observing the motions of other mens' lips, and to understand grammar, morals, religion, and even the most abstract sciences.

SECTION VIII.

Of the Senses in general.

ANIMAL bodies are composed of different substances: some of which, as the bones, the fat, the blood, the lymph, &c. are insensible; and others, as the membranes and nerves, seem to be active substances, which give spring and vivacity to all the members. The nerves are the immediate instruments of feeling: their nature indeed is diversified by a difference in their disposition: according to their arrangement, position, and quality, they convey to the mind different species of feeling, which have been distinguished by the name of sensations, and which seem in effect to have no resemblance to each other. If we consider, however, that all the external senses proceed solely from nervous expansions differently arranged and situated; that the nerves are the general organ of feeling; and that no other substance in the animal body is endowed with this faculty; we shall be inclined to believe, that the senses have one common origin, and that as all nerves are only various forms of the same individual substance, the sensations which result from them differ not so essentially from each other as they at first appear.

The body of the eye is perhaps an expansion of the optic nerve only. Its situation is more external than that of any other nerve; and it likewise conveys the most lively and the most delicate sensation. It must, therefore, be affected by the smallest particles of matter, as those of light, and of course convey to the mind sensations of all distant bodies which either emit or reflect light. The situation of the ear is more internal than that of the eye; neither is it furnished with so large an expansion of nervous substance, and must of course be endowed with a less degree of sensibility, and cannot be affected with particles of matter so minute as those of light. But it is capable of being affected by

grosser particles; and it transmits to the mind sensations of such distant bodies as are endowed with the faculty of putting these particles in motion. As these particles are grosser, and have less velocity than those of light, they can move a short way only, and consequently the sensations conveyed to us by the ear are much more limited, as to distance, than those afforded by the eye. The membrane which is the seat of smell, is still less supplied with nerves than the ear, and can give us sensations only by the intervention of particles of matter which are grosser and nearer the organ, as those that issue from odorous bodies. These particles probably consist of the essential oils, which exhale and float in the air, as light bodies swim in water: and, as the nerves are still fewer and more divided on the tongue and palate, odoriferous particles are too weak to affect them. To produce the sensation of taste, the oily or saline parts must be detached from other bodies, and applied to the tongue. This sense differs greatly from that of smelling. The latter conveys sensations of bodies at a certain distance; but the former requires actual contact, and perhaps the solution of particular parts of bodies, as their salts, oils, &c. before any sensation is communicated. Lastly, as the nerves are minutely divided, and thinly spread over the skin, it cannot be affected by the particles of which light, sound, or odours, are composed. Nothing less than contact can give us the ideas which are proper to the sense of touching; and, of course, it conveys to us no information with regard to distant objects.

Hence the difference between the senses appears to proceed from the situation of the nerves being more or less external, and from the greater or smaller quantity of them bestowed on the different organs. It is for this reason that a nerve, when irritated by a blow, or laid bare by a wound, frequently gives us the sensation of light without the intervention of the eye; and, from the same cause, we often feel the sensation of sound, when the ear is not affected by any thing from without.

When the particles of light or of sound are collected in great quantities, they form a kind of solid mass, and produce sensations of different species, which seem to have no analogy with the original sensations: a very great assemblage of luminous particles affect not only the eyes, but the nerves of the skin, in which they excite the sensation of heat, which is a feeling different from that of vision, though it be produced by the same cause. Heat, therefore, is a sensation proceeding from contact with light, which acts as a solid body, or as a mass of matter in motion. This action of light, like other bodies in motion, is apparent when light substances are exposed to the focus of a burning glass: before they are heated, the action of the light communicates to them a motion, by which they are driven from their former station. Here heat acts like solid bodies upon each other, since it is capable of displacing light substances, and of communicating to them a motion by actual impulse.

In the same manner, when the particles of sound are collected in great quantities, they produce a sensible agitation on the body, which is very different from the action of sound on the ear. A violent explosion, or a clap of thunder, produces a succussion in us, and in every neighbouring body. Here sound likewise acts as a solid body. This tremulous motion is not occasioned by the agitation of the air; for we perceive not that it is accompanied with wind; and besides, even the strongest wind does not produce such violent concussions. It is owing to this action of the sonorous particles, that the vibrations excited in one string are communicated to the others; and the tremulous sensation we feel from a violent noise is very different from the sensation of sound in the ear, though it be an effect of the same cause.

All the varieties in our sensations proceed from the greater or lesser quantity of nerves, and from their position being more or less external. This is the reason why some of the senses, as the eye, the ear, the nose, are affected by the minute particles which issue from particular substances; and why others, as the senses of tasting and touching, require actual contact, or emanations of the grossest kind, by the latter of which we receive the sensations of the solidity, or fluidity, and of the heat of bodies.

A fluid differs from a solid, because its particles have no coherence, or are not gross enough to admit of being laid hold of on different sides at the same time. The particles of fluids touch one another but in one, or so few points, that none of them can have any great degree of adhesion with another. Solid bodies, even when reduced to an impalpable powder, do not absolutely lose their solidity; because their particles, by touching each other in many points, still preserve a degree of cohesion; and this is the reason why we can squeeze them together, and form them into large tangible masses.

The sense of feeling extends over the whole body; but its exertions are different in different parts. The sensation of touching is excited by the application of foreign bodies to some part of our own body. If a foreign body be applied to the breast or shoulders, we feel it; but we have no idea of its figure, because the breast or shoulder touches the foreign body on one side only. The same remark is applicable to other parts which are incapable of folding round, or embracing at one time, several sides of foreign bodies. The idea of figure can only be acquired by the flexible parts of the body, as the hands, which, from their structure, are

enabled to feel different parts of surfaces at the same time.

The hand is not the principal object of touch because the extremities of the fingers are furnished with a great quantity of nervous papillæ, but because it is divided into several parts, which are all flexible, all act at the same time, and are all obedient to the will. This alone is the source of all our ideas of figure and of magnitude. The surface of the hand and fingers is greater, in proportion, than any other part of the body, because no other part is so much divided. This advantage, when joined to the flexibility of the fingers, renders the hand the most perfect instrument for conveying ideas of the figures of bodies. If the hand were divided into 20 or more fingers, these ideas would be still more precise and exact; if, on the contrary, their present number were diminished, or if the hand were totally deprived of fingers, our ideas of figure would be very confused and indetermined.

Those animals which are furnished with hands appear to have most sagacity. Apes imitate the mechanical actions of man so completely, that they seem to be excited by the same sensations. But all animals which are deprived of hands can have no distinct idea of the figure or magnitude of objects; because none of their parts are sufficiently flexible and divided, to enable them to twist round the substances of bodies. This is the reason why animals are often terrified at objects which ought to be familiar to them. The muzzle is their principal organ of feeling, because it is divided into two parts by the mouth, and because the tongue serves both for touching bodies, and for turning them over, which they often do before they seize them with their teeth. It is likewise probable, that animals which are furnished with many instruments of feeling, as the cuttle-fish, the polypus, and other insects, have a superior faculty of distinguishing and of choosing what is agreeable or convenient for them. Hence fishes whose bodies are covered with scales, ought to be the most stupid of animals, because they can have no knowledge of the form of objects; and a very obtuse sense of feeling must be conveyed through the scales. Hence also all animals which have not divided extremities, as arms, legs, paws, &c. must have a more obtuse sense of feeling than those that are furnished with these instruments of sensation. Serpents, however, are less stupid than fishes; because, though their skin is hard and scaly, they have the faculty of twisting round bodies, and of obtaining by this means more accurate conceptions of the forms and qualities of these bodies.

Thus the two chief obstacles to the exercise of the sense of feeling proceed, first, from the uniformity of the bodies of animals, or from their want of flexible and divided extremities; and, secondly, from the materials which cover the skin, as hair, feathers, scales, shells, &c. The harder and more solid this covering is, the sense of feeling will be less acute, and the finer and more delicate the skin, the sensation of feeling will be the more lively and exquisite. Women, among other advantages over the men, have a finer skin, and a more delicate perception of feeling.

The skin of a fœtus, while in the womb of the mother, is extremely delicate. It ought, therefore, to have a lively sense of external impressions. But as it swims in a liquor, and as fluids blunt the action of every shock from without, the fœtus is rarely hurt, and never without some violence received by the mother. Thus the sense of feeling, though it depends on the fineness of the skin, and is extended over the whole body, can have little exercise in the fœtus-state: a fœtus, therefore, though it may touch different parts of its own body with its hands, can have no distinct sensations arising from the sense of feeling.

To a new-born infant the hands are equally useless as they are to a fœtus; because, by the absurd practice of swaddling, they are not allowed to employ them during six or seven weeks after birth. The improvement of the sense of feeling, from which we derive all our knowledge, is by this means unquestionably retarded. If a child had the free use of its hands the moment it came into the world, it would sooner acquire ideas of the figure and magnitude of objects: and who can determine the influence which our first ideas have upon those that are afterwards acquired? one man, perhaps, excels another in genius and ability, only because he has been permitted, at a more early period, to make an unrestrained use of the sense of feeling. Infants, as soon as they are allowed to employ their hands, endeavour to touch every object they see. They delight in handling every thing they can seize: by feeling every part of bodies, they seem to be desirous of acquiring exact ideas of their form. It is in this manner they amuse, or rather instruct, themselves with new objects: and this passion for novelty continues to be our amusement during life.

It is by the sense of feeling alone that we acquire real knowledge. The innumerable errors into which we are led by the illusions of the other senses are corrected by feeling. But how is this important sense originally unfolded? how do primary ideas arrive at the mind? have we forgot every trace of what passes in the darkness of infancy? how shall we recall the first impressions of thought? do not inquiries of this nature imply presumption and temerity? if the subject were less momentous, we might be liable to censure. But the mind cannot, perhaps, be occupied with a subject more worthy of research; and every effort ought to be exerted in the contemplation of great objects.

Let us suppose, then, a man in the same situation

with him who first received existence; a man whose organs were perfectly formed, but who was equally new to himself and to every external object which surrounded him: what would be this man's first sensations, and his first judgments concerning himself, and the objects of his sensations? were he to give a history of his thoughts, and of the manner in which he received impressions, what information would he convey?

SECTION IX.

Of the Varieties of the human Species.

WHAT we have hitherto remarked concerning the generation of man and the structure of his body, constitutes the history of the individual only: that of the species requires a separate detail, the principal facts of which must be collected from the varieties that appear among men in different regions of the earth. These varieties may be reduced to three heads: 1. The colour; 2. The figure and stature; and 3. The dispositions of different people. Each of these heads, if extensively considered, might afford materials for a volume; but we shall confine ourselves to those which are most general and best ascertained.

With this view we shall survey the surface of the earth, commencing with the northern regions.

In Lapland, and on the northern coasts of Tartary, we find a race of men of an uncouth figure and small stature. Their countenances are equally savage as their manners. These men, who appear to be a degenerated species, are very numerous, and occupy vast regions. The Danish, Swedish, and Muscovite Laplanders, the inhabitants of Nova Zembla, the Borandians, the Samoiedes, the northern Tartars, the Ostiacks of the Old Continent, and the Greenlanders and savages to the north of the Esquimaux Indians in the New Continent, appear to be all the same race, who have extended and multiplied along the coasts of the north sea, in deserts, and under climates which could not be inhabited by other nations. All these people have broad large faces and flat noses. (See le Voyage de Regnard, tom. i. p. 169.; Il Genio vagante del Conte Aurelio degli Anzi; et les Voyages du Nord faits par les Hollandois.) Their eyes are of a yellowish brown colour inclining to black, (see Linnæi Fauna Suecica, 1746. p. 1.); their eye-lids extend towards the temples, (see La Martiniere, p. 39.); their cheek-bones are very prominent; their mouths are large, and their lips thick and reflected; the under part of their face is narrow; they have a squeaking voice; the head is large, the hair black and smooth; and the skin is of a tawny or swarthy hue. Their size is diminutive; but, though meagre, their form is squat. Most of them are only four feet high; and their tallest men exceed not four feet and a half. This race is so different from all others, that it seems to constitute a distinct species; for if there be among them any distinction, it arises only from a greater or less degree of deformity. The Borandians, for example, are still less than the Laplanders. The iris of their eyes is of the same colour, but the white is of a reddish yellow: their skin is more tawny; and their legs, instead of being slender, like those of the Laplanders, are very thick and shapeless. The Samoiedes are more squat than the Laplanders; their heads are larger; their noses are broader, and their complexion darker; their legs are shorter; their hair is longer, and their beards are more scanty. The skin of the Greenlander is more tawny than that of the other nations, being of a deep olive colour; and, it is said, that some of them are as black as the Æthiopians. Among all these people the women are fully as ugly as the men, whom they resemble so much, that the distinction is not easily perceived. The women of Greenland are very short; but their bodies are well proportioned. Their hair is blacker, and their skin softer than those of the Samoiede females. Their breasts are so long and pliable, that they can suckle their children over their shoulders. Their nipples are black as jet, and their skin is of a very deep olive colour. Some travellers alledge that these women have no hair but upon their heads, and that they are not subject to the menstrual evacuation. Their visage is large; their eyes small, but black and lively; and their feet and hands are short. In every other respect they resemble the Samoiede females. The savages north of the Esquimaux, and even in the northern parts of the Island of Newfoundland, have a great resemblance to the Greenlanders. Like them their stature is small, their faces broad, and their noses flat; but their eyes are larger than those of the Laplander.

These people not only resemble each other in deformity, in smallness of stature, and in the colour of their eyes and hair, but also in their dispositions and man-

ners: they are all equally gross, superstitious, and stupid. The Danish Laplanders have a large black cat, to which they communicate their secrets, and consult in all their important affairs; such as, whether this day should be employed in hunting or fishing. Among the Swedish Laplanders, a drum is kept in every family for the purpose of consulting the devil; and, though they are a robust and nimble people such is their pusillanimity, that they never could be persuaded to face a field of battle. Gustavus Adolphus endeavoured to embody a regiment of Laplanders; but he was obliged to relinquish the project. They cannot, it should appear, exist but in their own country, and in their own manner. To enable them to travel on the snow, they use skates made of fir-wood, about two ells long, and half a foot broad. These skates are raised before, with a hole in the middle for tying them firm on the foot. With these they run on the snow with such rapidity, that they easily overtake the swiftest animals. They carry with them a pole pointed with iron at one end, and rounded at the other. This pole serves to push them along, to direct their course, to preserve them from falling, to stop their impetuosity, and to kill the animals they overtake. With these skates they descend the most frightful precipices, and climb the steepest and most rugged mountains. The skates used by the Samoiedes are shorter, and seldom exceed two feet in length. Among all these people, the women use skates as well as the men. They likewise employ the bow and the cross-bow; and it is said, that the Muscovite Laplanders dart a javelin with so much force and dexterity, that, at the distance of 30 paces, they are certain of hitting a mark not larger than a crown-piece; and that, at the same distance, they will transfix a human body. They hunt the ermine, the lynx, the fox, and the martin, and barter their skins for brandy and tobacco. Their food consists principally of dried fish, and of the flesh of the rein-deer and bear. Their bread is composed of the pounded bones of fishes, mixed with the tender bark of the pine or birch-tree. Most of them make no use of salt. Their usual drink is whale-oil, or water in which juniper-berries have been infused. They seem to have no idea of religion, or of a Supreme Being. They are mostly idolaters, and exceedingly superstitious. More gross than savages, they have neither courage, dignity, nor a sense of shame. The manners of these abject people serve only to render them despicable. They bathe naked, and promiscuously, boys and girls, mothers and sons, brothers and sisters, without feeling the smallest sense of impropriety. When they come out of the baths, which are extremely warm, they immediately plunge themselves into cold rivers. They offer their wives and daughters to strangers, and esteem it the highest affront if the offer be rejected. This custom is universal among the Samoiedes, the Borandians, the Laplanders, and the inhabitants of Greenland. In winter, the Laplanders clothe themselves with the skin of the rein-deer, and, in summer, with the skins of birds. The use of linen is unknown to them. The women of Nova Zembla pierce their noses and their ears, and decorate them with pendants of blue-stone; and, to increase their charms, they draw blue streaks across their forehead and chin. Their husbands cut their beards into a round form, and wear no hair on the head. The Greenland women clothe themselves with the skin of the dog-fish. They likewise paint their faces blue and yellow, and wear pendants in their ears. They all live under ground, or in huts almost sunk below the surface, and covered with the bark of trees, or bones of fishes. It is a common practice with them, during winter, to make subterraneous communications from hut to hut, by which they can visit their neighbours without going abroad. A night, consisting of several months, obliges them to illuminate their dreary abodes with lamps, in which they burn the same whale-oil that serves them for drink. In summer they have hardly more ease than in winter; for they are obliged to live perpetually in a thick smoke. This is the only means they have hitherto contrived to guard themselves against the bite of the gnats, which are perhaps more numerous in this frozen country than in the Torrid Zone. Notwithstanding this melancholy and hard mode of living, they are seldom or ever sick, and all arrive at extreme old age. Even the old men are so vigorous, that it is difficult to distinguish them from the young. Blindness, which is very frequent among them, is the only malady to which they are subject. As their eyes are perpetually dazzled with the reflection from the snow in winter, autumn, and spring, and involved in smoke during summer, few of them retain their sight after they are advanced in years.

It is therefore apparent, that the Samoiedes, the Zemblians, the Borandians, the Laplanders, the Greenlanders, and the savages to the north of the Esquimaux, are the same race of men; because they resemble one another in figure, in stature, in colour, in manners, and even in singularity of customs. The custom of offering their wives and daughters to strangers, and of being vain when the offer is accepted, may proceed from a sense of their own deformity, as well as that of their females, whom they are apt to think the more handsome, because they are not despised by strangers. At any rate, it is certain that this practice is general among all these nations, though very distant from each other, and though separated by a great sea. We meet with it among the Crim Tartars, the Calmucks, and several other nations in Siberia and Tartary, who are almost equally ugly as the inhabitants of the more northern regions. In all the neighbouring nations, on the contrary, as China and Persia, where the women are beautiful, the men are remarkable for their jealousy.

In examining the different nations adjacent to that vast tract of land occupied by the Laplanders, we find no relation between them and the race last mentioned. The Ostiacks and Tongusians, who border on the Samoiedes on the south and south-east, are the only people who have any resemblance to them. The Samoiedes and Borandians have no similarity to the Russians. The Laplanders resemble not, in any manner, the Fins, the Goths, the Danes, or the Norwegians. The Greenlanders are totally different from the savages of Canada, who are large and well made; and, though the tribes differ from one another, yet none of them have any analogy to the Laplanders. The Ostiacks, however, seem to be a less ugly, and a taller branch of the Samoiedes. They feed upon raw flesh or fish; they eat all kinds of animals without distinction; they prefer blood to water for their drink; like the Laplanders and Samoiedes, they are mostly idolaters; in a word, they appear to be the line which divides the Lapponian and Tartarian races; or, rather, the Laplanders, the Samoiedes, the Borandians, the Nova Zemblians, and perhaps the Greenlanders, and the Dwarfs of North America, may be considered as Tartars reduced to the lowest degree of degeneracy. The Tongusians seem to be less degenerated than the Ostiacks; because the former, though sufficiently ugly, are taller, and better proportioned. The Samoiedes and Laplanders lie under the 68th or 69th degree of latitude, but the Ostiacks under the 60th. The Tartars, who are situated along the Wolga, in the latitude of 55, are gross, stupid, and brutal. Like the Tongusians, they have no idea of religion; and they will not marry girls till they have had intercourse with other men.

The Tartars occupy immense regions in Asia. They spread over that vast tract of country extending from Russia to Kamtschatka, a space of 11 or 12 hundred leagues in length, by more than 750 in breadth, which is a territory above 20 times larger than the kingdom of France. The Tartars border with China, the kingdoms of Boutan, and of Alva, and the Mogul and Persian empires, as far as the Caspian Sea, on the north and west. They spread along the Wolga and the west coast of the Caspian, as far as Daghestan; they have penetrated to the north coast of the Black Sea, and have establishments in Crimea, in Little Tartary near Moldavia, and in the Ukraine. All these people, even in their youth, have large wrinkled foreheads; their noses are thick and short, and their eyes small and sunk; their cheek-bones are very high, and the lower part of their face is very narrow; their chin is long and prominent, and the upper jaw falls in; the teeth are long and distinct from each other; the eye-brows are thick, and cover the eyes; the face is flat; the skin is tawny or olive; and the hair is black. Their bodies are of a middle stature, but strong and robust. They have little beard, and the hairs are disposed in tufts, like the beards of the Chinese. Their thighs are thick, and their legs short. The Calmuck Tartars are the most ugly; there is even something frightful in their countenance. They are all wandering vagabonds, living in tents made of cloth or of skins. They eat the flesh of horses, and of other animals, either raw, or a little softened, by putrifying under their saddles, and likewise fishes dried with the sun. Their common drink is mares milk fermented with the flour of millet. They all shave the head, except a little tuft which they allow to grow, in order to form two tresses, one of them to hang on each side of the face. The women, who are as ugly as the men, wear their hair, in which they fix little pieces of copper, and other ornaments of the same nature.

In most of these tribes, no marks of religion, or of decency in their manners, are to be found. They are all robbers; and the Tartars of Daghestan, who border on civilized nations, have a great trade in slaves, whom they carry off by force, and then sell them to the Turks and Persians. Their wealth consists chiefly of horses, which are, perhaps, more numerous in Tartary than in any other country on the globe. These people live perpetually with their horses, and are continually occupied in training, dressing, and exercising them. They manage their horses with such address, that a stranger would imagine both creatures to be animated with the same mind. These horses not only obey the gentlest motions of the bridle, but they seem to know the very intention of their riders.

To learn the particular differences which subsist among the race of Tartars, we have only to compare the descriptions given by travellers of their different tribes. We are informed by Tavernier, that the Calmucks, who live in the neighbourhood of the Caspian Sea, between Muscovy and Great Tartary, are robust men, but the most ugly and deformed beings under heaven. Their faces are so large and so flat, that their eyes, which are generally small, are situated five or six inches asunder. Their noses are so low, that, instead of nostrils, two holes are only to be seen; and their knees bend outward, and their legs inward. After the Calmucks, the Tartars of Daghestan hold the next rank in deformity. The Little Tartars, or those of Nogai, who live near the Black Sea, are not so ugly as the Calmucks, though they have flat faces, and small eyes, and resemble the Calmucks in their general figure. By their intercourse with the Circassians, the Moldavians, and other adjoining nations, this race of Tartars have perhaps lost a part of their original deformity. The Tartars of Siberia, though, like the Calmucks, they have broad faces, short flat noses, and small eyes, and though their language be very different, there is still so great a similarity between them, that they ought to be regarded as the same race of people. The Tartars of Bratski are considered by Pere

Avril as of the same race with the Calmucks; and, in proportion as we advance eastward, and approach Independent Tartary, the features of the Tartars gradually soften; but the characters essential to their race are never obliterated. Lastly, the Mongou-Tartars, who conquered China, and were the most polished, though their features be less disagreeable, yet, like all the other tribes, they have small eyes, large flat faces, thin black or red beards, short sunk noses, and a tawny complexion. The people of Thibet, and of the other southern provinces of Tartary, are also less deformed. Mr. Sanchez, first physician to the Russian army, a man of great learning and ability, has obliged me with the following remarks made by him in travelling through Tartary.

In the years 1735, 1736, and 1737, he visited the Ukraine, the banks of the Don as far as the sea of Zabach, and the confines of Cuban, as far as Asoph. He traversed the deserts which lie between the country of the Crims and Backmut. He journeyed among the wandering Calmucks from the kingdom of Casan to the banks of the Don, among the Tartars of Crimea and Nogai, who wander between the Crimea and the Ukraine, and likewise among the Tartars of Kergissi and Tcheremissi, who are situated to the north of Astracan, from the 50th to the 60th degree of latitude. He remarked, that the Tartars of Crimea and of the province of Cuban, were of a middle stature; and that they had broad shoulders, narrow flanks, strong nervous limbs, black eyes, and a tawny complexion. The Tartars of Kergissi and Tcheremissi are smaller and more squat; they are grosser, and less agile; they have black eyes, a tawny hue, and faces still broader than the former. He observed, among these Tartars, several men and women who had no resemblance to them, and of whom some were as white as the inhabitants of Poland. As these nations abound with slaves, both male and female, who are carried off from Russia and Poland; as their religion permits a plurality of wives and concubines; and as their Sultans, Murzas, or Nobles, bring their wives from Circassia and Georgia, the children who spring from such alliances are less deformed, and whiter than those of the unmixed natives. There are even among the Tartars a whole nation, that of the Kabardinski, who are remarkably beautiful. M. Sanchez saw no less than 300 of these men in the Russian service; and he assures us, that he never saw men make a more handsome figure. Their countenances were as fresh and white as any in Europe; they had large black eyes; and they were tall and well proportioned. He adds, that the lieutenant-general of Serapikin, who had lived long in Kabarda, informed him, that the women were equally beautiful. But this notion, so totally different from the other Tartar tribes with which they are surrounded, continues M. Sanchez, are said to have come originally from the Ukraine, and had been transported into Kabarda about 150 years ago.

The blood of the Tartars is mixed on one side with the Chinese, and, on the other, with the oriental Russians. But the characteristic features of the race are not entirely obliterated by this mixture; for, among the Muscovites, the Tartarian aspect is very frequent; and, though the former have sprung from the common European race, we still find many individuals with squat bodies, thick thighs, and short legs, like the Tartars. But the Chinese have so great a resemblance to the Tartars, that it is uncertain whether they be not of the very same race: the most remarkable difference arises from a total disparity in their dispositions, manners, and customs. The Tartars are fierce, warlike, and fond of hunting. They love fatigue and independence; and they are hardy and brutally gross. But the manners of the Chinese are the very reverse. They are effeminate, peaceable, indolent, superstitious, submissive, ceremonious, and parasitical. In their features and form, however, they have a great resemblance to the Tartars.

The Chinese, says Hugon, are large and fat men, with well-proportioned limbs, round broad faces, small eyes, large eye-brows, high eye-lids, and small sunk noses. They have only seven or eight tufts of hair on each lip, and very little on the chin. Those who live in the southern provinces are browner and more tawny than those in the northern parts; and their colour resembles that of the people of Mauritania, or the more swarthy of the Spaniards: but, in the middle provinces, they are as white as the Germans. According to Dampier and others, they are not all large and fat, though they regard these properties as great ornaments to the human figure. Speaking of the inhabitants of the island of St. John, on the coast of China, Dampier informs us, that they are tall, erect, and not incumbered with fat; that they have a long visage and a high forehead; that their eyes are small, their nose pretty large and elevated in the middle, their mouth of a moderate size, their lips thin, their complexion ash-coloured, and their hair black; that they have naturally little beard; and that they pull out all the hairs, except a few on the chin and upper lip. According to Gentil, the Chinese have nothing disagreeable in their aspect, especially in the northern provinces: those whom necessity exposes to the sun, in the southern provinces, are tawny. In general, they have small oval eyes, short noses, and thick bodies of a middle stature. He assures us, that the women use every art to diminish their eyes; and that the young girls, instructed by their mothers, continually extend their eye-lids, in order to make their eyes small and oblong, which, when joined to a flat nose, and large, open, pendulous ears, constitute a perfect beauty. He adds, that their complexion is fine, their lips of a beautiful red, their mouths well-

shaped, and their hair exceedingly black; but that the chewing of beetle blackens their teeth, and their constant use of paint so greatly injures their skin, that they have the appearance of old age before they arrive at 30 years.

We are assured by Palafox that the Chinese are whiter than the oriental Tartars; that they have also less beard; but that in every other respect there is little difference in the visages of these two nations. It is very uncommon, he says, to see blue eyes either in China or the Philippine Islands, except the Europeans, or those born of European parents.

It is alledged by Innigo Biervillas, that the women of China are better made than the men. The faces of the latter, he observes, are large, and their complexions yellowish; their noses are broad and compressed; and their bodies are thick and coarse like those of Dutchmen: the women, on the contrary, are exceedingly handsome; their skin and complexion are admirably fine; and their eyes are extremely beautiful: but few of them, he adds, have good noses, because they are purposely compressed in their infancy.

Most of the Dutch voyagers agree that the Chinese, in general, have broad faces, small eyes, flat noses, and hardly any beard; that the natives of Canton, and all along the southern coast, are as tawny as the inhabitants of Fez in Africa; but that those of the interior provinces are mostly white. Now if we compare the descriptions of the Tartars and Chinese given by the different authors above quoted, we cannot hesitate in pronouncing, that the Chinese, though they differ a little in their stature, and in the form of their countenance, have a greater relation to the Tartars than any other people, and that all the differences between them proceed entirely from climate and the mixture of races. This is the opinion of Chardin: 'The size of the Little Tartars,' he remarks, 'is about four inches less than that of the Europeans; 'and they are thicker in the same proportion. Their 'complexion is copper-coloured; their faces are broad, 'flat, and square; their noses are compressed, and their 'eyes small. Now, these are the exact features of the 'Chinese; for, after the most minute examination, during 'my travels, I found that all the people, to the east and 'north of the Caspian Sea, and to the east of the Peninsula of Malacca, have the same configuration of face, 'and nearly the same stature. From this circumstance, 'I was induced to think, that all these people, notwithstanding the varieties in their manners and complexion, 'sprung from the same source; for differences in colour 'proceed entirely from climate and the manner of living; 'and varieties in manners originate from the soil, and 'from the degrees of opulence enjoyed by different 'nations. (See Chardin, tom iii. p. 86.)

Father Parennin, who lived long in China, and accurately observed the manners of that people, informs us, that the neighbouring nations in the west, from Thibet northward to Chamo, differed from the Chinese in manners, language, features, and external conformation; that they are a rude, ignorant, slothful people, faults very uncommon among the inhabitants of China; that when any of these Tartars come to Pekin, and the Chinese are asked the reason of these differences, they answer, that they are occasioned by the water and the soil; or in other words, that the nature of the country produces these changes in the bodies and dispositions of its inhabitants. He adds, that this remark seems to be more verified in China than in any other country he ever saw; and that when following the Emperor in a journey to Tartary, as far as the 48th degree of north latitude, he found Chinese families from Nankin, who had settled there, whose children had become perfect Mongous, having their heads sunk between their shoulders, crooked legs, and an aspect that was truly gross and disgusting. (See Recueil 24. des Lettres Edifiantes.)

The Japanese are so very similar to the Chinese, that they may be regarded as the same race of men; their colour is indeed darker, because they live in a more southern climate. In general their complexion is vigorous; their stature short; their face and nose broad and flat; their eyes small; their beard thin; and their hair black. They are haughty, warlike, full of vigour and dexterity, civil and obliging, smooth-tongued, and abound in compliments; but they are a vain and inconstant people. They sustain with incredible patience hunger, thirst, cold, heat, fatigue, and all the other hardships of life. Like the Chinese they eat their meat with small sticks, and during their meals they use a multitude of ceremonies and strange grimaces. They are laborious, skilful artificers; and in a word, their dispositions, manners, and customs, are nearly the same with those of the Chinese.

The absurd custom of rendering the feet of their women so small that they can hardly support their bodies is common to both nations. Some travellers affirm, that when the Chinese girls arrive at three years of age, their feet are bended in such a manner, that the toes lie under the sole; that they apply aquafortis to burn off the flesh; and then wrap them up in strong bandages. They add, that the women feel the consequences of this operation all their lives; for they walk with much difficulty, and their gait is exceedingly ungraceful. They chearfully submit however to this inconveniency; and as it is a mean of pleasing, they endeavour to make their feet as small possible. Other travellers deny that they break the feet, and alledge, that they only compress them so forcibly as to prevent their growth: but all agree, that every woman of fashion, and every woman that is reckoned handsome, must have her feet so small

that they could enter with ease into the shoe of a child of six years of age.

We may therefore, upon the whole, conclude, that the Japanese and Chinese are the same race of people; that their civilization is of a very ancient date; and that they differ more from the Tartars in their manners than in their figure. Their early civilization may be ascribed to the fertility of the soil, the mildness of the climate, and the vicinity of the sea; while the Tartars, removed from the sea, and separated from the southern nations by high mountains, have continued to wander in their vast deserts, and under a climate, the rigour of which, especially in the northern parts of Tartary, could only be supported by a robust and uncultivated people. The country of Jesso, which lies to the north of Japan, though situated under a climate which ought to be temperate, is however cold, barren, and mountainous: its inhabitants are also totally different from those of China and Japan. They are a gross brutal race, having neither manners nor arts. Their bodies are thick and short; their hair is long and bristly; their eyes are black; their forehead is flat, and their colour yellow, though less so than that of the Japanese. Their faces, as well their whole body, are very hairy. They live like savages, and their food consists of the fat and oil of whales, and other fishes. They are exceedingly indolent and slovenly in their dress. Their children go almost naked; and the women have invented no other ornament but that of painting their eye-brows and lips of a blue colour. The sole pleasure and occupation of the men is hunting bears and rein-deer, and fishing whales. Though they have some Japanese customs, as that of singing with a quavering voice, yet in general they have a greater resemblance to the northern Tartars or the Samoiedes than to the natives of Japan.

In examining the people on the south and west of China, we find that the Cochin-chinese, who inhabit a mountainous region that lies south of China, are more tawny and more ugly than the Chinese; and that the Tonquinese, whose country is more fertile, and who live under a colder climate than the Cochin-chinese, are more handsome and beautiful. Dampier tells us, that the Tonquinese are of a middle stature; and that, though their complexion be tawny, their skin is so smooth and delicate, that the smallest changes from redness to paleness are perceptible in their faces, a circumstance which distinguishes them from the other Indians. Their visage is generally flat and oval, their nose and lips well proportioned, their hair black, long, and very thick; and they use every art to make their teeth black. According to the relations annexed to Tavernier's voyages, the Tonquinese are of a good stature, and of an olive colour. They have not the flat faces and noses of the Chinese; and they are in general much handsomer.

Thus it appears that these nations differ little from the Chinese: in colour they resemble the inhabitants of the southern provinces of China. If they are more tawny, it is owing to their living under a warmer climate; and though their faces and noses be more prominent, they may still be regarded as people sprung from the same origin.

The same observation is applicable to the natives of Siam, of Pegu, of Aracan, of Laos, &c. The features of all these nations have a striking resemblance to those of the Chinese; and though they differ from the Chinese in colour, yet they differ much more from the other Indians. The stature of the Siamese, according to Loubere, is rather small; their bodies are well made; their faces are large, and their cheek-bones prominent; their forehead suddenly contracts, and terminates in a point, like the chin; their eyes are small and oblique; the white of the eye is yellowish; the cheeks are hollow, from the elevation of the upper part of the cheek-bones; the mouth is large, the lips thick, and the teeth black; their complexion is coarse, being a mixture of brown and red, or according to other travellers, of an ash-colour, which is perhaps as much owing to the perpetual sultriness of the air as to their birth: their nose is short and rounded at the point; their ears are naturally large, and are much esteemed when their size is remarkably great. This taste for long ears is common to all the eastern nations. Some draw the lob of the ear in order to lengthen it, and pierce it so as only to allow the admission of an ordinary pendant; and others, as the natives of Laos, widen the holes in their ears so prodigiously, that they will almost admit a man's hand; and by this means their ears descend to the top of their shoulders. With regard to the Siamese, however, their ears are naturally a little larger than ours. Their hair is coarse, black, and straight; and it is worn so short, both by the men and the women, that it reaches no lower than the ear all round the head. They anoint their lips with a kind of perfumed pomatum, which makes them appear unnaturally pale. They have little beard; and they always pull out the hairs: nor is it customary to pare their nails, &c. Struys informs us, that the women of Siam wear pendants in their ears so large and heavy, that the holes gradually grow wide enough to admit a thumb. He adds that the colour of both men and women is tawny; that, though not tall, they are handsome; and that in general the Siamese are a mild and polished people. Father Tachard remarks, that the Siamese are very alert, and have among them dancers and tumblers as agile as those in Europe. He tells us, that the custom of blackening their teeth proceeds from a notion they entertain of its being unseemly for men to have white teeth like the brutes. They besmear them with black varnish, and abstain three or four days from meat, in order to make it adhere the more firmly.

The inhabitants of the kingdoms of Pegu and Aracan

differ not from those of China and Siam, except in their colour, which is a little blacker. The natives of Aracan are fond of large flat foreheads; and to render them so, they apply a plate of lead to the foreheads of their children immediately after birth. They have large open nostrils, small sparkling eyes, and ears so long that they rest upon their shoulders. They eat, without disgust, mice, rats, serpents, and putrified fish. Their women are tolerably fair, and their ears are equally long as those of the men. The people of Achen, who are still farther north than those of Aracan, have likewise flat visages, and olive complexions. They are exceedingly gross, and allow their boys to go quite naked; and the girls have only a thin plate of silver to save their blushes.

All these nations, it is apparent, differ little from the Chinese, and resemble the Tartars in the smallness of their eyes, their flat visages, and their olive colour. But, in proceeding southward, the features begin to be diversified in a more sensible manner. The inhabitants of Malacca, and of the island of Sumatra, are black, small, active, and well-proportioned. Though naked from the middle upwards, except a small scarf which they carry sometimes on one shoulder and sometimes on the other, they are naturally brave, and become formidable after taking their opium, which affects them with a kind of furious intoxication. The inhabitants of Sumatra and Malacca, according to Dampier, are of the same race. They speak nearly the same language; they have all a fierce and haughty temper; their stature is of a middle size; they have a long visage, black eyes, noses of a moderate bulk, thin lips, and teeth dyed black by the frequent use of beetle. In the island of Pugniatan, or Pissagan, about 16 leagues west of Sumatra, the natives are tall, and of a yellow colour, like the Brasilians. They wear long smooth hair, and go absolutely naked. Those of the islands of Nicobar, to the north of Sumatra, are of a yellowish tawny complexion, and likewise go perfectly naked. Dampier tells us, that the natives of the Nicobar islands are tall and handsome; that their visage is long, their hair black and smooth, and their noses of a moderate size; and that the women tear out the hairs from their eye-brows, &c. The natives of the island of Sombrero, to the north of Nicobar, are very black; and they paint their faces with different colours, as green, yellow, &c. The people of Malacca, of Sumatra, and of the small adjacent islands, though they differ between themselves, differ still more from the Chinese, Tartars, &c. and seem to have originated from a different race; yet the natives of Java, who are in the neighbourhood of those of Sumatra and Malacca, have no resemblance to them, but are similar to the Chinese, except in colour, which, like that of the Malays, is red mingled with black. They likewise resemble, says Pigafetta, the natives of Brazil; their complexion is coarse, and, though neither remarkably large nor small, they are squat, and exceedingly muscular; their faces are flat, their cheeks flabby and pendulous; their eye-brows large, and inclined to the temples; their eyes small, and their beards very black and thin. Father Tachard remarks, that the people of Java are robust and handsome; that they seem to be active and resolute; and that the extreme heat of the climate obliges them to go naked. From the Lettres Edifiantes, it appears, that the natives of Java are neither black nor white, but of a purplish red colour; and that they are mild, familiar, and courteous.

Francis Legat relates, that the women of Java, who are not exposed to the rays of the sun, are less tawny than the men; that their countenance is comely, their breasts prominent and well-shaped, and their complexion, though brown, uniform and beautiful; that they have a delicate hand, a soft air, brilliant eyes, an agreeable smile; and that many of them dance with great elegance and spirit. Most of the Dutch voyagers agree, that the natives of this island are robust, well made, and nervous; that their visage is flat, their cheeks broad and prominent, their eye-lids large, their eyes small, their hair long, and their complexion tawny; that they have little beard; that they wear their hair and nails very long; and that they polish their teeth with files. In a little island fronting that of Java, the women are tawny, have small eyes, a large mouth, flat noses, and long black hair.

From all these relations, we may conclude, that the inhabitants of Java greatly resemble the Tartars and Chinese, while those of Malacca, Sumatra, and the small adjacent islands, differ from the Chinese, both in their features and in the form of their bodies. Neither is it difficult to account for this phænomenon; for the peninsula of Malacca, the islands of Sumatra and Java, as well as all the other islands in the Indian Archipelago, must have been peopled by the neighbouring nations on the continent, and even the Europeans themselves, who have had possession of them near three centuries. This circumstance must have produced a great variety among the inhabitants, as well in the features and colour, as in the form and proportions of their bodies. In the island of Java, for example, there are a people called Chacrelas, who are totally different, not only from the natives of this island, but from all the other Indians. These Chacrelas are white and fair; and their eyes are so weak that they cannot support the rays of the sun. They go about, in the day, with their eyes half shut, and directed to the ground; but they see best during the night. All the inhabitants of the Molucca islands, says Pyrard, are similar to those of Sumatra and Java, in manners, mode of living, arms, customs, language, colour, &c. We learn from Mandelslo, that the men are rather black than tawny, and that the women are fairer; that their hair is black; that their eyes, eye-brows, and eye-lids

are large; that their bodies are strong and robust; that they are dexterous and agile; and that they live long, though their hair soon becomes hoary. This traveller likewise tells us, that each island has its own peculiar language, and that they have probably been peopled by different nations. The inhabitants of Borneo and of Bali, he adds, are rather black than tawny; but, according to other travellers, they are only brown, like the other Indians. Gemelli Carreri says, that the inhabitants of Ternate are of the same colour with the Malays, which is a little darker than those of the Philippine islands; that their countenances are comely; that the men are handsomer than the women; and that both sexes bestow much care on their hair. The Dutch travellers relate, that the natives of the island of Banda are remarkable for longevity; that they have seen a man aged 130, and many who approached to that uncommon period of life; that these islanders are in general exceedingly indolent; that the men do nothing but saunter abroad; and that all the laborious offices are executed by the women. According to Dampier, the original natives of the island of Timor, which is one of those most adjacent to New Holland, are of a middle stature: they have erect bodies, delicate limbs, a long visage, black bristly hair, and a very black skin: they are dexterous and agile, but indolent to a shameful degree. In another place, however, he says, that the inhabitants along the bay of Laphao are mostly tawny and of a copper colour, and that their hair is black and flat.

Turning northward, we find Manilla and the other Philippine islands, the inhabitants of which, by alliances formed between the Spaniards, the Indians, the Chinese, the Malabars, the Negroes, &c. are perhaps more mixed than those of any other part of the universe. Those negroes, who live in the rocks and woods of Manilla, are entirely different from the other inhabitants. Some of them have crisped hair, like the negroes of Angola, and others long hair; their colour consists of various shades of black. Among these, some have been seen who had tails four or five inches long, like the islanders mentioned by Ptolemy. This traveller adds, that he was informed by Jesuites worthy of credit, that, in the island of Mindora, which is adjacent to Manilla, there is a race of men called Manghians, who have all tails of the same length; that some of these tailed men had even embraced the Catholic faith; and that they had olive complexions and long hair. Dampier tells us, that the inhabitants of the island of Mindanao, which is one of the principal and most southerly of the Philippines, are of a middle stature; that their limbs are slender, their bodies thin and straight, their visages oval, their foreheads flat, their eyes black and small, their noses short, their mouths large, their lips thin and red, their teeth black, their hair smooth and black, their colour tawny and more yellow than several of the other Indian tribes; that the women are handsome and fairer than the men; that their visage is longer, and their features sufficiently regular, except the nose, which is short and flat; that their limbs are small, and their hair long and black; and that the men, in general, are alert and ingenious, but slothful and addicted to robbery. We learn from the Lettres Edifiantes, that the inhabitants of the Philippine islands resemble the Malays, who formerly conquered these islands; that, like them, the nose is short, the eyes large, the complexion of a yellowish olive colour, and that their customs and language are nearly the same.

To the north of Manilla lies the island of Formosa which is not far distant from the province of Fokien in China. But these islanders have no resemblance to the Chinese. Struys informs us, that the men of this island are of small stature, particularly those who live in the mountains; that they have flat faces; that the women have coarse full breasts, and a beard like the men; that their ears are long, and their length is increased by heavy shells which they employ for pendants; that their hair is black and long, and their complexion of a yellowish black colour; that some of them are of a whitish yellow, and others entirely yellow; that they are extremely indolent, dexterous in managing the bow and the javelin, excellent swimmers, and run with incredible swiftness. Struys expressly declares, that, in this island, he saw a man with a tail more than a foot long, covered with reddish hair, and not unlike that of an ox; and that this tailed man assured him, that the tail was a consequence of the climate, for all the natives of the southern part of the island had tails of the same kind.

I know not what credit is due to this relation of Struys: if the fact concerning the tails be true, it must be exaggerated; for it accords not with the accounts of other travellers, nor even with that of Ptolemy; and Marc Paul, in his Geographical description, says, that in the mountains and in the kingdom of Lambry, there are men with tails about a palm long only. It appears that Struys rests upon the authority of Marc Paul, as Gemelli Carreri does upon that of Ptolemy; and that the tail he pretends to have seen is very different in its dimensions from that ascribed by other travellers to the negroes of Manilla, the inhabitants of Lambry, &c.

The Dutch voyagers, in their accounts of the natives of Formosa, differ from all those we have hitherto mentioned. Mandelslo, as well as the writers of the collection of voyages which paved the way for the establishment of the Dutch East India Company, inform us, that these islanders are taller than the Europeans; that their colour is brownish black; that their bodies are hairy; and that the women are of a low stature, but robust, fat, and tolerably proportioned. In most of the writers concerning this island, there is no mention of men with tails; and they differ widely from each other in their

descriptions of the form and features of the natives. But, with regard to one fact, which is no less extraordinary, they seem entirely to agree, namely, that the women are not permitted to bear children till the age of 35, though they are at liberty to marry long before that period. Speaking of this custom, Rechteren expresses himself in the following terms: 'after marriage, the women are not allowed to be mothers till 'they have completed their 35th or 37th year. When 'they are pregnant before this period, their priestesses 'trample with their feet upon the women's bellies, and 'in this manner force them to miscarry, an operation 'much more painful and dangerous than a natural 'labour: but it is disgraceful, and even a high crime, 'to allow a child to come into the world before the age 'prescribed. I have seen women who had 16 of these 'forced miscarriages, and were only permitted to bring 'forth their 17th child.'

The Mariana or Ladrone islands, which are the most remote from the eastern coast, are inhabited by a rude and unpolished people. Father Gobien tells us, that, till the arrival of the Europeans, they had never seen fire, and that they were extremely surprised when this element was first exhibited to them by Magellan. Their colour is tawny, though somewhat fairer than that of the natives of the Philippines; they are stronger and more robust than the Europeans; they are tall and well proportioned: though they feed solely on roots, fruits, and fish, yet they are fat and corpulent; but their corpulency prevents them not from being nimble and active. They live so long, that the age of 100 years is not extraordinary among them, without ever experiencing disease or sickness. We are told by Gemelli Carreri, that the natives of these islands are of a gigantic size, and that they are so strong, that they can with ease carry on their shoulders a weight of 500 pounds. In general, their hair is crisped, their nose and eyes are large, and their complexion is like that of the Indians. The inhabitants of Guan, one of these islands, have long black hair, a large nose, thick lips, white teeth, a long visage, a ferocious aspect; they are likewise exceedingly robust; and their stature, it is said, extends to seven feet in height.

To the south of the Mariana islands, and eastward of the Moluccas, we find the land of the Papous and New Guinea, which seem to be the most southerly regions of the globe. According to Argensola, the Papous are as black as the Caffres, have crisped hair, and a meagre and disagreeable visage: among these people, however, there are some who are as white and fair as the Germans; but their eyes are weak and delicate. We are also informed by Le Maire, that the natives of this country are very black, savage and brutal. They wear rings in their ears and noses, and sometimes in the partition of the nose. They likewise wear bracelets of mother of pearl above the elbows and on the wrists, and they cover their heads with caps made of the bark of trees, painted with different colours. They are strong and well-proportioned, have black teeth, a pretty good beard, and black and crisped hair, though not so woolly as that of the negroes. They are swift in the chace; and, as the use of iron is unknown to them, their weapons consist of clubs, lances, and spears, made of hard wood. They likewise use their teeth as offensive weapons, and bite like dogs. They eat beetle and pimento mixed with chalk, which also serves them for powder to their beards and hair. Their women have a disgustful aspect: they have long breasts which hang down to the navel, very prominent bellies, small arms and limbs, the visage of an ape, and hideous features. Dampier tells us, that the natives of the island of Sabala, in New Guinea, are a kind of tawny Indians, with long black hair, and who differ not in manners from those of the island of Mindanao, and of the other eastern isles; that, beside these, who appear to be the principal inhabitants of New Guinea, there are also negroes with frizzled woolly hair. Speaking of another of these islands, called Garret-Denys, our author remarks, that the inhabitants are black, robust, and well made; that they have large round heads, and short crisped hair, which they cut in different fashions, and paint with various colours, as red, white, and yellow; that they have large round faces, and broad and flat noses; that their countenances, however, would not be absolutely disgusting, if they did not thrust through their nostrils a kind of peg, about an inch thick and four inches long, so that each end of it rests upon their cheek-bones, and only a small part of the nose appears around this unnatural ornament; and that they wear similar pegs in their ears.

The natives of the coast of New Holland, which is situated in the 16th degree of south latitude, and beyond the island of Timor, are perhaps the most miserable of the human species, and approach nearest to the brutes. They are tall, erect, and thin; their limbs are long and slender: they have large heads, a round forehead, and thick eye-brows: their eye-lids are always half shut, a habit which they contract in infancy, to protect their eyes from the gnats; and, as they never open their eyes, they cannot see at a distance, without raising their heads as if they were looking at something above them. They have thick noses and lips, and large mouths: they pull out, it should appear, the two fore-teeth of the upper-jaw; for, in neither sex, nor at any period of life, are these teeth to be seen. They have no beard; their visage is long, without a single feature that is agreeable; their hair is short, black, and crisped; and their skin is as black as that of the Guinea Negroes. They have no cloathing but a piece of the bark of a tree tied round their waist, with a handful of long herbs in the middle. They have no houses, and they sleep on the ground

without any covering. They associate, men, women, and children, promiscuously, to the number of 20 or 30. Their only nourishment is a small fish, which they catch in reservoirs made with stones in small arms of the sea; and they are totally unacquainted with bread, and every species of grain.

In another part of the coast of New Holland, about the 22d or 23d degree of south latitude, the natives seem to be of the same race with those we have now described. They are extremely ugly and disgusting, and have the same defect in their eyes; their skin is black, their hair crisped, and their bodies are tall and slender.

From these descriptions, it is apparent, that the islands and coasts of the Indian ocean are peopled with men of very different races. The natives of Malacca, of Sumatra, and of the Nicobar islands, seem to derive their origin from the inhabitants of the peninsula of Indus; and those of Java from the Chinese, except the white men called *Chacrelas*, who must have sprung from the Europeans. The natives of the Molucca islands seem also in general to have proceeded from the Indian peninsula. But the inhabitants of the island of Timor, which lies nearest to New Holland, are very similar to the people of that country. Those of Formosa, and of the Mariana islands resemble each other in stature, strength, and features; and they appear to form a race entirely distinct from every other people in the neighbourhood. The Papous, and other nations adjacent to New Guinea, are real negroes, and resemble those of Africa, though they are separated from that continent by a tract of sea more than 2200 leagues over. The natives of New Holland have a strong analogy to the Hottentots. But before drawing any conclusions from all these relations and differences, it is necessary to examine the condition of the nations of Asia and Africa.

The Moguls, and other natives of the peninsula of India, nearly resemble the Europeans in traits and features; but they differ more or less from them in colour. The Moguls are olive, though, in the Indian language, Mogul signifies white. The women are extremely handsome, and make frequent use of bathing. Like the men, they are of an olive colour, and what is opposite to the women of Europe, their legs and thighs are long, and their bodies short. Tavernier says, that after passing Lahor, and the kingdom of Cashmire, the Mogul women have naturally no hair on any part of the body, and that the men have very little beard. According to Thevenot, the Mogul women are chaste, very fruitful, and bring forth with so much ease, that they frequently walk the streets the very next day after delivery. He adds, that in the kingdom of Decan the men marry at ten, and the women at the age of eight years, and that they have often children at this early period; but the women who have children so soon, commonly cease to bear after the age of 30, when they are wrinkled, and have all the appearances of decrepitude. Some of these women have their skin punctured in the form of flowers, and painted with the juices of plants, which gives the skin the appearance of being stuffed with flowers.

The natives of Bengal are yellower than the Moguls; their manners are also totally different; their women, instead of being chaste, are supposed to be the most lascivious in India. A great slave-trade, both of males and females, is carried on in this country; and a number of eunuchs are made, both by a simple privation of the testicles, and by a total amputation of the parts. The Bengalians are handsome and beautiful; they love commerce, and have a great deal of mildness in their manners.

The natives of the Coromandel coast are blacker than those of Bengal; they are also less civilized, and go almost naked. Those of the Malabar coast are still blacker. They have very long, smooth, black hair, and are of the same size with the Europeans. The women wear gold rings in their noses; and the men, women, and young girls, bathe promiscuously in ponds made for the purpose in the middle of their towns. The women, though black, or at least exceedingly brown, are comely and handsome, and they marry at the age of eight years.

The customs of the different Indian nations are all very singular, if not whimsical. The Banians eat nothing that is animated; they even dread to kill the smallest insect, and will not destroy the louse that bites them. They throw rice and beans into the rivers, to nourish the fishes, and grain upon the ground to feed the birds and insects. When they meet a hunter or a fisher, they earnestly beg of him to desist: if he be deaf to their entreaties, they offer him money for his gun or net; and if he does not comply, they trouble the waters to frighten the fishes, and set up hideous cries to put the birds and other game to flight.

The Naires of Calicut form a band of nobles whose only profession is that of arms. These men, though of an olive colour, are comely and handsome. They are tall and hardy, full of courage, and very dexterous in the management of their weapons. They lengthen their ears to such a pitch, that they hang down on their shoulders, and sometimes lower. These Naires are allowed only one wife; but the women may have as many husbands as they please. Father Tachard, in his letter to Father la Chaise, dated at Pondicherry, February 16, 1702, tells us, that in the cast or class of nobles, a woman sometimes has ten husbands, whom they regard as slaves subjected to their beauty. This privilege is confined to ladies of rank; for the women of inferior condition are allowed but one husband: the latter indeed take care to alleviate this hardship by their commerce with strangers, to whose embraces they abandon themselves without reserve; and their husbands dare

not challenge them. The mothers prostitute their daughters even before they arrive at a proper age. The Naires or nobles of Calicut seem to be of a different race from the burgesses; for the latter, both males and females, are of a smaller stature, and are worse shaped and more ugly. Among the Naires there are some men as well as women whose legs are as thick as the body of an ordinary man. This deformity is not a consequence of disease; for they have it from their birth. In some this monstrous thickness is confined to one leg only. The skin of these legs is hard and rough like a wart: notwithstanding this cumbersome deformity, the persons affected with it are nimble and active. This race of men with thick legs have not multiplied greatly, either among the Naires or the other Indians. They however appear in other places, and especially in Ceylon, where they are said to be of the race of St. Thomas.

The natives of Ceylon are similar to those of the Malabar coast. Though they are not equally black, they have large ears which hang down to their shoulders. Their aspect is mild; and they are naturally alert, dexterous, and vivacious. Their hair, which is very black, is worn short by the men. The common people go almost naked; and the women, according to a custom pretty general in India, have their bosoms uncovered. In the northern part of the island of Ceylon, there is a species of savages called Bedas, who occupy only a small district, and seem to be of a peculiar race. The spot they inhabit is entirely covered with wood, in which they conceal themselves so closely, that it is difficult to discover any of them. Their complexion is fair, and sometimes red, like that of the Europeans. Their language has no analogy to any of the other Indian languages. They have no villages or houses, and hold no intercourse with the rest of mankind. Their arms consist of bows and arrows, with which they kill a number of boars, stags, and other animals. They never dress their meat; but they season it with honey, with which they are plentifully provided. We are ignorant of the origin of this tribe, who are not numerous, and who live in detached families. These Bedas of Ceylon, as well as the Chacrelas of Java, who are both fair and few in number, appear to be of European extraction. It is probable, that some European men and women have been formerly left on these islands by shipwreck or otherwise, and that, for fear of being maltreated by the natives, they and their descendants confined themselves to the woody and mountainous parts of the country, where they continue to live a savage life, which perhaps wants not its charms to those who are accustomed to such a mode of living.

The natives of the Maldiva islands are supposed to have descended from those of Ceylon, though there is no resemblance between them: for the natives of Ceylon are black and deformed; but those of the Maldiva islands are handsome, and, except their olive colour, differ little from the Europeans; besides, they are a people composed of all nations. The inhabitants of the northern parts of these islands are more civilised than those who inhabit the southern parts. The women, notwithstanding their olive colour, are beautiful, and some of them are as fair as the Europeans. Their hair is universally black, which they regard as a beauty, and studiously render the hair black, by shaving the heads of their boys and girls every eight days, till they arrive at the age of nine or ten. This practice, it is probable, contributes to blacken the hair; for though every man and woman has black hair, that of their children is sometimes pretty fair. Another beauty among the women is to have their hair very long and very thick, and for this purpose, they anoint their head and body with a perfumed oil. The men are more hairy than those of Europe. These islanders love exercise, and are industrious artists; they are superstitious, and much addicted to venery: though the women carefully conceal their bosoms, they are exceedingly indolent and debauched; they perpetually eat beetle and other hot spices. As to the men, they are less vigorous than their spouses would incline.

The natives of Cambaia are more or less of an ash-colour; and those who live near the sea are more swarthy than the others. Those of Guzarat are yellow; and the Canarins, or the inhabitants of Goa and of the neighbouring islands, are olive.

We are informed by the Dutch voyagers, that the natives of Guzarat are more or less yellow; that their stature is the same with the Europeans; that the women, who seldom expose themselves to the sun, are fairer than the men, and that some of them are nearly as white as the Portuguese.

Mandelslo says, that the inhabitants of Guzarat are all more or less tawny, or olive, according to the climate under which they live; that the men are strong and well made, and have large faces and black eyes; that the women are little, but handsome; and that they wear long hair, pegs in their noses, and large pendants in their ears. There are very few deformed persons among them; some of them are fairer than others; but all have black straight hair. The ancient inhabitants of Guzarat are easily distinguished from the others by their colour, which is much blacker; they are likewise more barbabarous and stupid.

Goa is the principal settlement of the Portuguese in India; and though its ancient splendour is much decayed, it still continues to be an opulent and commercial city. It was formerly the greatest market for slaves in the whole world. Handsome women and girls were sold here from every nation of Asia. These slaves were of all colours; and they were skilled in music, and in every species of sewing and embroidery. The Indians

were most enamoured with the Caffre girls from Mosambique, who are all black. 'It is remarkable,' says Pyrard, 'that the sweat of the Indians, whether male 'or female, has no unsavoury odour, while the stench 'of the African negroes, when they are over-heated, is 'perfectly insupportable.' He adds, that the Indian women are fond of the European men, and prefer them even to the white Indians.

The Persians are adjacent to the Moguls, and have a great resemblance to them; those especially who inhabit the southern parts of Persia differ very little from the Indians. The natives of Ormus, and of the provinces of Bascia and Balascia, are very brown and tawny; those of Chesmur, and of the other provinces of Persia, where the heat is not so great as at Ormus, are fairer; and those of the northern provinces are tolerably white. According to the Dutch travellers, the women in the islands of the Gulf of Persia are brown or yellow, and not at all agreeable. They have a large visage, and ugly eyes. In some of their manners and customs they resemble the Indian women, as those of wearing rings in the cartilage of the nose, and of passing a gold pin through the skin of the nose, near the eyes. Indeed, this custom of piercing the nose for the purpose of embellishing it with rings and other trinkets, has extended much farther than the Gulf of Persia; many of the Arabian women wear rings in their noses; and it is a piece of gallantry among the men to salute their wives through these rings, which are sometimes so large that they encircle the whole mouth.

Xenophon says, that the Persians were generally thick and fat. Marcellinus, on the contrary, tells us, that, in his time, they were thin and meagre. Olearius agrees with the last author, and adds, that they are strong and hardy; and that they are of an olive colour, and have black hair and aquiline noses.

That the blood of the Persians, says Chardin, is naturally gross, appears from the Guebres, who are a remnant of the ancient Persians, and are an ugly, ill made, rough skinned people. This is also apparent from the inhabitants of the provinces in the neighbourhood of India, who are nearly as clumsy and deformed as the Guebres, because they never form alliances with any other tribes. But, in the other parts of the kingdom, the Persian blood is now highly refined by frequent intermixtures with the Georgians and Circassians, two nations who surpass all the world in personal beauty. There is hardly a man of rank in Persia who is not born of a Georgian or Circassian mother; and even the King himself is commonly sprung, on the female side, from one or other of these countries: as it is long since this mixture commenced, the Persian women have become very handsome and beautiful, though they do not rival the ladies of Georgia. The men are generally tall and erect; their complexion is ruddy and vigorous, and they have a graceful air, and an engaging deportment. The mildness of the climate, joined to their temperance in living, have a great influence in improving their personal beauty. This quality they inherit not from their fathers; for, without the mixture mentioned above, the men of rank in Persia, who are descendants of the Tartars, would be extremely ugly and deformed. The Persians, on the contrary, are refined and ingenious; their imagination is lively and fertile; though warlike, they are lovers of the arts and sciences; they are vain, and extremely ambitious of praise; their temper is soft and ductile; they are voluptuous, and much addicted to gallantry and intrigue; they are luxurious and prodigal, and equally strangers to œconomy and to commerce.

The Persians, though in general pretty sober, devour vast quantities of fruit. Nothing is more common than to see a man eat 12 pounds of melons; some will devour three or four times that quantity; and many of them fall a sacrifice to this excessive appetite for fruit.

Fine women, of all complexions, are common in Persia; for they are selected by the merchants, from every country, on account of their beauty. The white women are brought from Poland, from Muscovy, from Circassia, from Georgia, and from the frontiers of Great Tartary: the tawny women are transported from the Mogul's dominions, and from the kingdoms of Golconda and Visapore, and the blacks from Melinda and the coasts of the Red Sea. A strange superstition prevails among the inferior class of women. Those who are barren, imagine passing under the dead bodies of suspended criminals, will render them fruitful; they even believe that the influence of a male corpse, though at a distance, is sufficient to impregnate them.

When this absurd remedy does not succeed, they go into the canals of water which run from the baths, when they know that many men are employed in bathing themselves; and, if this specific be equally unsuccessful as the former, their last resource is to swallow that part of the prepuce which is cut off in the operation of circumcision, which they consider as a sovereign remedy against sterility.

The inhabitants of Persia, of Turkey, of Arabia, of Egypt, and of all Barbary, may be regarded as the same race of people, who, in the time of Mahomet and his successors, extended their dominions by invading immense territories, and became exceedingly diversified by intermixing with the original natives of all these different countries. The Persians, the Turks, and the Moors, have acquired a degree of civilization: but the Arabs have generally continued in a state of lawless independency. Like the Tartars, they live without government, without law, and almost without society. Rape, theft, and robbery, are authorized by their chiefs.

They glory in their vices, and have no regard to virtue; and they despise every human institution, except those only which produce superstition and fanaticism.

The Arabs, however, are enured to labour. They likewise accustom their horses to undergo the greatest fatigue, and allow them to drink only once in 24 hours. Their horses are meagre, but swift, and almost indefatigable. These people live in extreme misery. They have neither bread nor wine; neither do they take the trouble of cultivating the ground. In place of bread, they use some wild grain, which they mix and knead with the milk of their cattle. They have flocks of camels, sheep, and goats, which they conduct from place to place till they find sufficient herbage for them: here they erect their tents, which are made of goats hair, and live with their wives and children till the grass is consumed; they then decamp, and go in quest of another fertile spot. Though their mode of living be hard, and their food extremely simple, the Arabs are strong and robust; even their stature is not small, and they are pretty handsome. But their skin is scorched with the heat of the sun; for most of them go either entirely naked, or are covered only with a tattered shirt. Those who live on the coasts of Arabia Felix, and of the island of Socotora, are of smaller stature; their complexion is ash-coloured or tawny, and in the form of their bodies they have a great resemblance to the Abyssinians. The Arabs paint their arms, their lips, and the most conspicuous parts of their body, of a deep blue colour. This paint, which they lay on in small dots, and make it penetrate the flesh by means of a needle made for the purpose, can never be effaced. This singular custom prevails likewise among the Negroes who trade with the Mahometans.

Among the Arabs who live in the deserts on the frontiers of Tremesen and Tunis, the girls, to improve their beauty, paint their bodies with cyphers of a blue colour, which they accomplish by means of vitriol and the point of a lancet. In this they are followed by the country Africans, but not by those that live in towns; for there they preserve the same colour they bring with them into the world. Some of them, indeed, paint a small flower on their cheek, their forehead or their chin, with the smoke of galls and saffron, which makes a fine black colour: they likewise blacken their eye-brows. La Boulaye informs us, that the Arabian women of the Desert paint their hands, lips, and chin, of a blue colour; that most of them wear rings of gold or silver, about three inches diameter, in their noses; that, though they are born fair, their complexions are spoilt by being continually exposed to the sun; that the young girls are extremely agreeable, and sing perpetually; but their songs are not melancholy and plaintive, like those of the Turks, but have a still stranger effect, because they raise their voice to the highest pitch, and articulate with great rapidity.

'The Arabian princesses and ladies,' another traveller remarks, 'whom I was permitted to see, were extremely 'handsome, beautiful, and fair, because they are always 'covered from the rays of the sun. But the common 'women, beside their natural tawny complexion, are 'very much blackened by the sun; their form is exceed-'ingly disagreeable, and, except those natural attractions 'which always accompany youth, I could never perceive 'any thing in their appearance that could please 'the fancy. These women puncture their lips with 'needles, and cover them with gunpowder and the gall 'of oxes, which penetrate the skin, and render their 'lips blue and livid during life. They practise the same 'art upon the angles of the mouth, on each side of the 'chin, and upon the cheeks. They blacken the eye-lids 'with a black powder, and draw a black line from the 'corner of each eye, in order to make them appear more 'expanded; for the chief beauty of the eastern women 'consists in large prominent eyes. Female beauty 'among the Arabs is expressed by saying, That she has 'the eyes of the antelope. They always compare their 'mistresses to this sprightly animal; and black eyes, 'and the eyes of the antelope, are the principal topics 'of their love songs. The antelope is indeed a most 'beautiful and handsome creature, and has in its aspect 'a certain degree of innocent timidity, which resembles, 'in a striking manner, the modesty and apprehension 'natural to young women. The ladies and new married 'wives blacken their eye-brows, and make them join in 'the middle of the forehead. They puncture their arms 'and hands, and form upon them the figures of animals, 'flowers, &c. and paint their nails of a reddish colour: 'the men also paint their hair and the tails of their 'horses with the same colour. The women pierce their 'ears in several places, for the purpose of hanging rings 'and broaches to them, and they also wear bracelets on 'their arms and legs.' To this account it may be added, that the Arabs are exceedingly jealous of their wives; and that, though they either purchase them, or carry them off by force, they treat them with gentleness, and even with respect.

The Egyptians, though adjacent to the Arabs, and though governed by the same laws, and professing the same religion, are very different in their manners and customs. In all the towns and villages along the Nile, for example, we find young girls destined by the public to the pleasure of travellers, without any obligation to pay for this indulgence. For this species of hospitality, they have houses filled with these girls; and it is a pious practice with rich men, when about to die, to found and endow houses for this charitable purpose. When any of these young women bring forth male children, the

mothers are obliged to rear them to the age of three or four years; after which the children are carried to the patron of the house, or his representatives, who then take charge of them, and employ them as slaves. But the female children continue with their mothers, and supply their place. The Egyptian women are very brown, but have lively eyes. Their stature is above the middle size; their dress is not agreeable; and their conversation is exceedingly tiresome. They are remarkable for bearing many children; and some travellers pretend, that the fertility occasioned by the inundation of the Nile is not limited to the soil alone, but extends to men and other animals. They add, that the women uniformly conceive after either drinking, or bathing in the new water; that, in July and August, the women are generally impregnated, and bring forth in April and May; and that the cows commonly produce two calves, and the ewes two lambs, &c. It is difficult to reconcile these benign influences of the Nile with the troublesome diseases it occasions; for M. Granger informs us, that the air of Egypt is unwholesome; that diseases of the eyes are frequent, and so very difficult to cure, that the patients generally lose their sight; that in Egypt there are more blind persons than in any other country; and that, during the increase of the Nile, most of the inhabitants are seized with obstinate dysenteries, occasioned by the salts with which the water is then impregnated.

Though the Egyptian women are commonly small, yet the men are of a good size. In general, both sexes are of an olive colour; and the higher we ascend from Cairo, the natives become more tawny, till we arrive at the confines of Nubia, where they are almost as black as the Nubians themselves. Idleness and cowardice are the principal vices of the Egyptians. Their chief employment through the day is drinking coffee, smoking tobacco, sleeping, and chattering in the streets. They are grossly ignorant, and yet they are puffed up with a fantastical vanity. Though they acknowledge that they have lost their ancient dignity, their skill in science and in arms, their history, and even their language, and that, from a valiant and illustrious nation, they have degenerated into slavery and cowardice; yet such is the haughtiness of their disposition, that they affect to despise all other nations, and are exceedingly offended when any person advises them to send their children into Europe to be instructed in the arts and sciences.

The numerous nations who inhabit the coasts of the Mediterranean, from Egypt to the Western ocean, and the internal regions of Barbary, as far as Mount Atlas, are composed of people of different races, as the original natives, Arabs, Vandals, and Spaniards; and, in more ancient times, the Romans and Egyptians peopled these territories with men of very different qualities. The inhabitants of the mountains of Arras, for example, have no resemblance in their aspect and complexion to the adjacent tribes. Their colour, instead of being tawny, is white and ruddy, and their hair is of a deep yellow; but that of the adjacent nations is black. From these circumstances Mr. Shaw thinks it probable, that they are descendants of the Vandals, who, after their expulsion, took refuge in certain parts of these mountains. The women of the kingdom of Tripoli, though adjacent to those of Egypt, have not the smallest resemblance to them. The former are tall, and consider height of stature as an essential article of beauty. Like the Arabian females, they puncture and paint their cheeks and chin; and, as in Turkey, they are so fond of red hair, that they paint that of their children with vermilion.

The Moorish women, in general, affect to wear their hair so long as to reach to their heels; and those whose hair is shorter, use false locks twisted round with ribands. They paint the hair of their eye-lids with black-lead, and they esteem the dark colour which this substance gives to the eyes as a singular beauty. This custom is both very general and very ancient; it was practised by the ladies of Greece and Rome, as well as by those of the East.

Most of the Moorish women would be reckoned handsome even in Europe. The skin of their children is exceedingly fair and delicate; and though the boys, by being exposed to the sun, soon grow swarthy; yet the girls, who keep more within doors, preserve their beauty till the age of 30, when they commonly give over child bearing: but, as a recompense for this early sterility, they are often mothers at the age of 11, and grandmothers at that of 22; and, as they live as long as the European women, they generally see several generations.

In reading Marmol's description of these different nations, it is obvious to remark, that the inhabitants of the mountains of Barbary are white, and that those of the plains and sea-coasts are very brown and tawny. He tells us, that the inhabitants of Capez, a city in the kingdom of Tunis, situated upon the Mediterranean coast, are poor, and very black; that those who live along the banks of the river Dara in the kingdom of Morocco, are exceedingly tawny; and that, on the contrary, the inhabitants of Zarhou, and of the mountains of Fez, on the side of Mount Atlas, are very fair: he adds, that the latter are so little affected with cold, that, in the greatest frosts and snow, they dress very lightly, and go with their heads uncovered during the whole year. And, with regard to the Numidians, he says, that they are rather tawny than black; that the women are pretty fair and jolly, though the men are meagre; but that the inhabitants of Guaden, at the extremity of Numidia, and on the frontiers of Senegal, are rather

black than tawny; that, on the other hand, the women of the province of Dara are beautiful and fresh-coloured; and that, through this whole region, there are multitudes of negroe slaves of both sexes.

It appears then, that, in the ancient Continent, all the people who live between the 20th and 30th, or 35th degree of north latitude, namely, from the Mogul Empire to Barbary, and even from the Ganges to the western coast of Morocco, differ but little from each other, except those varieties which have arisen from a mixture with more northern nations, who, from time to time, have conquered and peopled some of those vast regions. In this extensive territory, which stretches, within the same parallels, about 2000 leagues, the men in general are brown and tawny, but, at the same time, pretty comely and handsome. If we next examine those who live under more temperate climates, we shall find, that the natives of the northern parts of the Mogul and Persian empires, the Armenians, the Turks, the Georgians, the Mingrelians, the Circassians, the Greeks, and the people of Europe in general, are the fairest and most handsome men in the world; and that, however remote Cashmire may be from Spain, or Circassia from France, the natives of these countries, which are nearly at an equal distance from the equator, have a striking resemblance to each other. The people of Cashmire, Bernier remarks, are renowned for their beauty. They are as handsome as the Europeans, and have no features of the Tartarian visage; neither have they those flat-noses and pig-eyes so universal among the adjacent nations. Their women are exceedingly beautiful; and it is a common practice with strangers, when they come to the Mogul court, to provide themselves Cashmirian wives, that they may have children by them as fair as true Moguls.

The blood of Georgia is still more refined than that of Cashmire. In this country, not an ugly countenance is to be seen: and, with regard to the women, Nature has adorned them with a profusion of graces: they are tall, handsome, slender-waisted; and their faces are truly charming. The men are likewise very handsome. They are naturally ingenious; and, if their education did not render them extremely ignorant and debauched, they might make no inconsiderable progress in the arts and sciences. But there is not, perhaps, a country in the universe where drunkenness and libertinism have arrived at so high a pitch as in Georgia. Chardin tells us, that even the clergy are much addicted to wine; that they keep a number of female slaves in their houses, which they use as concubines: and that nobody is offended at this practice, because it is general, and even authorized. He adds, that he was informed by the prefect of the Capuchins, that the Patriarch of Georgia declares publicly, that the man who does not get drunk at their great festivals, as those of Easter and Christmas, is unworthy of the name of a Christian, and ought to be excommunicated. With all these vices, however, the Georgians are a civil, humane, grave, and peaceable people. They seldom indulge resentment; but, when they conceive a hatred against any person, they are never to be reconciled.

The women of Circassia, Struys remarks, are likewise exceedingly fair and beautiful. Their complexion consists of the most delicate tints. Their forehead is large and smooth; and, without the assistance of art, their eye-brows are so fine, that they resemble curved threads of silk. Their eyes are large, attracting, and full of fire. Their noses are well shaped, and their lips are perfect vermilion. Their mouth is small, and the perpetual residence of smiles; their chin is the termination of the completest oval. Their neck and throat are extremely handsome; their skin is white as snow; the colour of their hair is a beautiful black; their stature is tall, and their carriage easy. They wear a little black cap, upon which is fastened a roller of the same colour. But, what is extremely ridiculous, the widows, in place of this roller, wear a bladder of an ox or a cow, fully blown up with air, which disfigures them amazingly. In summer the women of inferior station wear only a shift, which is generally blue, yellow, or red, and open to the middle of the body. Their breasts are finely formed; and though, pretty familiar with strangers, they are faithful to their husbands, who are by no means jealous of them.

Tavernier also informs us, that the women of Comania and Circassia, like those of Georgia, are very handsome and beautiful; that they retain the freshness of their complexion till the age of 45 or 50; that they are all very industrious, and often employed in the most laborious offices. These people have preserved uncommon liberties in their laws regarding marriage. If a husband is not pleased with his wife, and makes the first complaint, the seigneur of the district sends for the wife, sells her, and provides the husband with another. The wife, if she makes the first complaint, enjoys the same privilege.

The Mingrelians, according to the relations of travellers, are as handsome and beautiful as the Georgians or Circassians, and they seem to be the same race of people. 'In Mingrelia,' says Chardin, 'there are women extremely handsome, of a majestic air, whose 'form and visage are enchanting, and their aspect 'attracts every beholder. Those who are less handsome, 'or advanced in years, daub their eye-brows, cheeks, 'forehead, nose, and chin, with coarse paint. Others 'paint their eye-brows only, and bestow much attention 'to their dress, which is similar to that of the Persians. 'They wear a veil, which covers only the crown and 'back part of the head. Though lively, civil, and affectionate, they are extremely perfidious; and there is

'no wickedness which they will not perpetrate, in order 'to procure, to preserve, or to get rid of their gallants. 'The men have likewise many bad qualities. They are 'all trained to robbery, which they study both as a 'business and an amusement. They relate, with ex-'treme satisfaction, the depredations they have com-'mitted, and derive from this polluted source their 'greatest praise and honour. In Mingrelia, falsehood, 'assassination, and theft, are good actions, and whore-'dom, bigamy, and incest, are virtuous habits. A man 'marries two or three wives at a time, and keeps as 'many concubines as he chooses. Husbands in this 'country are not jealous of their wives; and when a wife 'is detected in the act of infidelity, he has only a right 'to demand a pig from the gallant, who generally eats 'a share of it in company with the husband and wife. 'To have many wives and concubines they pretend to 'be a good and laudable practice, because it enables 'them to beget the more children, whom they sell for 'gold, or exchange for wares and provisions.' The Mingrelian slaves are not dear. A man, from 25 to 40 years, may be purchased for 15 crowns; and when far-ther advanced, for 8 or 10. The finest girls, from 13 to 18, cost only 20 crowns, a woman about 12 crowns, and children only 3 or 4.

The Turks, who purchase vast numbers of these slaves, are so blended with the Armenians, Georgians, Arabians, Egyptians, and even with the Europeans, that it is impossible to distinguish the real natives of Asia Minor, Syria, and the rest of Turkey. In general the Turks are robust, and tolerably well made; and crooked or deformed persons are rarely to be met with among them. Most of their women are likewise handsome and beautiful: they are also very fair, because they seldom go abroad, and never without being covered with a veil.

'There is not,' says Belon, 'a woman in Asia, how-'ever mean her condition, who has not a complexion 'fresh as a rose, and whose skin is not fair, delicate, and 'smooth as velvet: they make an unguent of Chian 'earth, with which they anoint their whole bodies be-'fore they go to bathe. Some likewise paint the eye-'brows of a black colour; while others eradicate the 'hairs with rusma, and paint artificial eye-brows in the form of a black crescent, which have a beautiful 'appearance at a distance, but are very ugly when viewed 'more closely. This custom however is extremely an-'cient.' He adds, that in Turkey neither men nor women wear hair on any part of the body except the head and chin; that they make an ointment, composed of equal quantities of rusma and quick-lime, diluted in water, which they apply before they enter the warm bath; that when they begin to sweat in the bath, the hairs fall off by simple rubbing with the hand, and the skin remains soft and smooth, without the least vestige of hair on it: he farther remarks, that in Egypt there is a shrub called *alcanna*, the leaves of which, when dried and pounded, make a yellow reddish paint, and with which the Turkish women tinge their hands, feet, and hair. With the same substance they paint the hair of their children and the manes of their horses.

The women of Turkey likewise use a preparation of tutty to render their eyes of a deeper black, They bathe often, use perfumes, and employ every art to pre-serve and improve their beauty. The Persian women are said to be still more anxious on this subject than the Turks. The men have also different tastes with regard to beauty; the Persians are fond of brown complexions, and the Turks prefer the red.

It has been alledged, that the Jews who came origi-nally from Syria and Palestine, still preserve their former darkness of complexion. But as is properly remarked by Misson, the Jews of Portugal alone are tawny, be-cause by constantly marrying those of their own tribe, the children of these people always resemble their pa-rents, and the tawny colour is thus perpetuated, with little diminution, even in the northern countries. The Jews of Germany however, as those of Prague, for ex-ample, are not more swarthy than the other inhabitants of that county.

The present natives of Judea resemble the other Turks; but they are more swarthy than those who live in Constantinople, or on the coasts of the Black Sea; in the same manner as the Arabians are browner than the Syrians, because they inhabit a more southern climate.

The same observation is applicable to the Greeks; the inhabitants of the north are fairer than those of the islands, or of the southern provinces. In general the Greek women are still more beautiful and vivacious than the Turks. They have likewise the advantage of enjoy-ing a greater degree of liberty. Gemelli Carreri informs us, that the women of the island of Chio are fair, beau-tiful, lively, and very familiar with the men; that the young girls see strangers without restraint; and that they all go with their necks uncovered. He like-wise remarks, that the Greek women, especially in the neighbourhood of Constantinople, have extremely fine hair; but that those whose hair descends to their heels are less regular in their features.

The Greeks esteem large eyes and high eye-brows as great points of beauty in either sex; and it is worthy of remark, that in all the busts and medals of the ancient Greeks, the eyes are much larger than in those of the ancient Romans.

The inhabitants of the Archipelago are remarkably fine swimmers and divers. Thevenot tells us, that they exercise themselves in bringing up sponges, and even lost goods, from the bottom of the sea; and that, in the

island of Samos, a young man cannot obtain a wife, unless he be able to dive at least eight, or according to Dapper, 20 fathoms. The latter adds, that in some of the islands, as that of Nicaria, they have a strange practice of conversing with each other at great distances; and that their voices are so strong, that at the distance of a quarter of a league, and sometimes of a whole league, those islanders can maintain a conversation, which is necessarily interrupted by long intervals, the answer not arriving till several seconds after the question.

The Greeks, the Neapolitans, the Sicilians, the Corsicans, the Sardinians, and the Spaniards, being situated nearly under the same latitude, are very similar in their complexions. All these people are more swarthy than the French, the British, the Germans, the Polanders, the Moldavians, the Circassians, and all the other inhabitants of the northern parts of Europe, till we advance to Lapland, where, as formerly remarked, we meet with another race of men. In travelling through Spain, a difference of colour is perceptible even at Bayonne; there the complexion of the women is browner, and their eyes are more brilliant.

The Spaniards, though meagre, are handsome. Their features are regular, their eyes beautiful, and their teeth well arranged: but their complexion is yellow and swarthy. Their children are born fair and beautiful; but as they grow up, their colour changes in a surprising manner; the operation of the air and of the sun soon renders them so yellow and tawny, that a Spaniard is easily distinguished from a native of any other country in Europe. In some provinces of Spain, as in the environs of the river Bidassao, it has been remarked, that the inhabitants have ears of an uncommon size.

Black or brown hair begins to be unfrequent in Britain, in Flanders, in Holland, and in the northern provinces of Germany; and in Denmark, Sweden, and Poland, it is seldom to be met with. Linnæus informs us, that the Goths are tall; that their hair is straight, and as white as silver; and that the iris of their eye is blueish. The Finlanders, he adds, are muscular and fleshy; their hair is long, and of a whitish yellow colour; and the iris of the eye is of a deep yellow.

The women of Sweden are very prolific. Rudbeck says, that they generally bring forth 8, 10, or 12 children; and that 18, 20, 24, and even 30, are not uncommon. He adds, that the men often exceed the age of 100 years; that some arrive at 140; and that one Swede lived 156, and another 161 years. But this author, it must be allowed, is an enthusiast with regard to his country; and in his estimation Sweden is the best country in the world. This extraordinary fertility in the Swedish women implies not an uncommon propensity to love. Mankind are more chaste in cold than in hot climates. Though the women of Sweden are less amorous than those of Spain or Portugal, yet they bring forth more children. The northern nations, it is well known, have over-run all Europe to such a degree, that historians have distinguished the North by the appellation of 'Officina Gentium.'

The author of the 'Historical Voyages of Europe' agrees with Rudbeck, that the Swedes live longer than any other people of Europe; and adds, that he saw several men who, he was assured, had exceeded their 150th year. This longevity of the Swedes he ascribes to the salubrity of the air. He makes the same remark with regard to Denmark: the Danes, he says, are tall and robust, of a lively and florid complexion, and on account of the salubrity of the air they respire, live very long: the Danish women are also fair, handsome, and extremely prolific.

Previous to the reign of the Czar Peter I. the Russians, we are told, were almost entirely barbarous. Born in slavery, they were ignorant, brutal, cruel, and had neither courage nor manners. Men and women often bathed promiscuously in baths heated to a degree that would have been insupportable to any other people: and like the Laplanders, immediately after coming out of these hot baths, they plunged themselves into cold water. Their food was extremely coarse. Cucumbers or melons, which they brought from Astracan, and preserved during the summer in a mixture of water, flour, and salt, were their favourite dishes. Some absurd scruples prevented them from eating particular meats, as pigeons and veal. But even at this unrefined period, the women knew the arts of colouring their cheeks, pulling out their eye-brows, and painting artificial ones. They also adorned themselves with jewels and pearls, and their garments were made of valuable stuffs. Is it not apparent, from these circumstances, that the barbarity of the Russians had already begun to decay, and that their sovereign had not such amazing difficulties in polishing them as some authors are desirous of insinuating? They are now a civilized and commercial people, they are fond of the arts and sciences, of public spectacles, and of ingenious novelties. Such important changes cannot be produced by a great man; but a great man may be born in a fortunate moment.

It has been alledged by some authors, that the air of Muscovy is so salubrious as to prevent the existence of pestilential contagion. It is recorded, however, in their own annals, that in the year 1421, and during the six subsequent years, the Muscovites were so dreadfully afflicted with contagious distempers, that the constitution of their descendants suffered a considerable change. Before that æra many men lived above 100 years; but very few now arrive at that age.

The Ingrians and Carelians, who inhabit the northern provinces of Muscovy, and are the natives of the country

round Petersburg, have vigorous and robust constitutions. Most of them have white or fair hair. They resemble the Finlanders, and speak the same language, which has no affinity to any of the other European tongues.

From the above historical account of all the inhabitants of Europe and Asia, it is apparent, that the differences in colour depend much, though not entirely, upon the climates. There are many other causes which have an influence upon the colour, and even upon the features and corporeal form of different people. The nature of the food is one of the principal causes; and we shall afterwards consider the changes it may produce. Manners, or the mode of living, may also have considerable effects. A polished people, who are accustomed to an easy, regular, and tranquil mode of life, and who, by the vigilance of a wise government, are removed from the dread of oppression and misery, will, for these reasons alone, be more strong, vigorous, and handsome, than savage and lawless nations, where every individual, deriving no succours from society, is obliged to provide for his own subsistence, to suffer alternately the pangs arising from hunger and from surfeits of unwholesome food, to sink under the fatigues of hard labour, to feel the rigours of a severe climate, without possessing the means of alleviating them, to act, in a word, more frequently like a brute than a man. Supposing two nations, thus differently circumstanced, to live under the same climate, it is reasonable to think, that the savage people would be more ugly, more tawny, more diminutive, and more wrinkled, than the nation that enjoyed the advantages of society and civilization. If the former had any superiority over the latter, it would consist in the strength, or rather in the hardiness, of their bodies. Among the savage people, there might likewise be fewer examples of lameness, and of other bodily impediments or deformities. Such men can live, and even multiply, in a polished state, where each individual contributes to the support of his neighbour, where the strong injure not the feeble, and where the qualities of the body are less esteemed than those of the mind. But among a savage people, as every individual must subsist and defend himself by corporeal strength and address alone, those who unfortunately come into the world with deformed bodies, or feeble constitutions, fall early victims to the defects of Nature.

Three causes, therefore, must be admitted, as concurring in the production of those varieties which we have remarked among the different nations of this earth: 1. The influence of climate; 2. Food, which has a great dependence on climate; and, 3. Manners, on which climate has, perhaps, a still greater influence. But before we attempt to establish this opinion by reasoning, it is necessary to give as minute a description of the inhabitants of Africa and America, as we have already given of those of Europe and Asia.

We have already mentioned the different nations who inhabit the northern parts of Africa, from the Mediterranean to the Tropic. All those beyond the Tropic, from the Red Sea to the Ocean, an extent of country about 100 or 150 leagues wide, are a species of Moors, though so swarthy, that they appear to be almost black. The men, in particular, are exceedingly brown; the women are a little fairer, well made, and tolerably beautiful. Among those Moors, there is a vast number of Mulattoes, who are of a still deeper black; because they are born of Negroe women whom the Moors purchase, and with whom they have many children. Beyond this territory, under the 17th or 18th degree of north latitude, we find the negroes of Senegal and of Nubia, both on the coast of the western ocean, and on that of the Red Sea; and then, from the 18th degree of north to the 18th of south latitude, the whole inhabitants of Africa, except the Ethiopians or Abyssinians, are perfectly black. Thus the portion of the globe allotted by Nature to this race of men, contains an extent of territory parallel to the Equator, of about 900 leagues in breadth, and considerably more in length, especially northward of the Equinoxial line. But, beyond the 18th or 20th degree of south latitude, the natives are no longer Negroes, as shall be evinced when we describe the Caffres and Hottentots.

We have long been deceived with regard to the colour and features of the Ethiopians, because they have been confounded with their neighbours the Nubians, who are a different race of people. Marmol tells us, that the Ethiopians are perfectly black, and that they have large faces and flat noses; and the Dutch travellers give the same description of these people. The truth, however, is, that the Ethopians differ from the Nubians both in colour and features. The natural colour of the Ethiopians is brown or olive, like that of the southern Arabs, from whom they probably derive their origin. They are tall, and have regular features, fine eyes, well proportioned noses, thin lips, and white teeth. But the Nubians have flat noses, thick prominent lips, and their visages are extremely black. These Nubians, like their western neighbours, are a species of Negroes, very similar to those of Senegal.

The Ethiopians are a half polished people. They wear garments of cotton and of silk. Their houses are low and ill built. In the culture of their lands they are extremely negligent; because the citizens and common people are despised, oppressed, and plundered by the nobles. Each of these classes lives separate from one another in their own villages or hamlets. Their country produces no salt, and the people purchase it for an equal weight of gold. They are fond of crude meat; and in

their feasts, the second course, which they regard as the most delicate, consists of flesh entirely raw. Though they have vines, they make no wine; and their only beverage is a sour composition of tamarinds and water. They travel on horses, and use mules for transporting their merchandize. Their knowledge of the arts and sciences is extremely limited; for their language is without rule, and their manner of writing is so imperfect, that they require several days to write a letter, though their characters are more beautiful than those of the Arabians. Their mode of salutation is singular: they take one another by the right hand, and mutually apply it to their mouths; the saluter then takes off the scarf of the person he salutes, and wraps it round his own body, by which the other is left half naked; for most of the Ethiopians wear only this scarf and a pair of cotton drawers.

Admiral Drake, in his voyage round the world, mentions a fact, which, though singular, appears not to be incredible. On the frontiers of the desert of Ethiopia, he remarks, there are men called Acridophagi, or locust-eaters, who are black, meagre, extremely nimble, and of small stature. In the spring-season, infinite numbers of locusts are transported into their country by certain hot winds which blow from the west. Having neither cattle nor fish, they are obliged to live upon these locusts, which they amass in vast quantities: they cure them with salt, and preserve them for food during the whole year. This wretched nourishment produces very strange effects: the people hardly reach the age of 40 years; and, when they approach to this period of life, winged insects are engendered under their skin, which at first create a violent itching, and soon multiply so amazingly, that their whole flesh swarms with them. They begin with devouring the belly, then the breast, and proceed in their ravages till they eat the whole flesh from the bones. Thus are those men, whom Nature forces to feed upon insects, devoured in their turn by these vermin. If this fact were well attested, it would afford ample scope for reflection.

In Ethiopia, and in that tract of land which stretches to Cape Gardufu, there are vast deserts. This country, which may be regarded as the most easterly part of Ethiopia, is almost entirely uninhabited. To the south, Ethiopia is bounded by the Bedwins, and some other nations, who observe the Mahometan law; a circumstance which corroborates the opinion, that the Ethiopians have originated from the Arabians. These two people are only separated by the straits of Babelmandel. It is probable, therefore, that the Arabians had formerly invaded Ethiopia, and obliged the natives of that country to retire to the northern parts of Nubia. The Arabians have even spread themselves along the coasts of Melinda; for the inhabitants of those coasts are only tawny, and follow the religion of Mahomet. Even in Zanguebar, the natives are not black; most of them speak the Arabic language; and they wear cotton stuffs. This country, though under the Torrid Zone, is not excessively hot; and the hair of the natives is black and crisped like that of the Negroes. Upon the whole of this coast, as well as at Mosambique and Madagascar, we meet with some white men, who, it is alledged, came originally from China, and settled there, when the Chinese were accustomed to sail over all the eastern seas, in the same manner as they are now navigated by the Europeans. Though this opinion be problematical, it is certain, that the nations of this eastern coast of Africa are black, and that the tawny or white people found there have come from other countries.

But, to form a just idea of the varieties which occur among these black nations, requires a more minute examination.

From comparing the testimonies of travellers, it, in the first place, appears, that the varieties among the blacks are equally numerous as those among the whites. The blacks, as well as the whites, have their Tartars and their Circassians. The natives of Guinea are extremely ugly, and have an insufferable odour: those of Sofala and of Mosambique are beautiful, and have no bad smell. It is, therefore, necessary to divide the blacks into different races; and, I think, they may be reduced to two principal races, that of the Negroes, and that of the Caffres. Under the first I comprehend the blacks of Nubia, of Senegal, of Cape Verd, of Gambia, of Sierra-Leona, of the Teeth and Gold Coasts, of that of Juda, Benin, Gabon, Loango, Congo, Angola, and of Benguela, as far as Cape Negro. Under the second, I include all the nations from Cape Negro to the point of Africa, where they assume the name of Hottentots, and all those on the eastern coast, within the same latitude, as the territories of Natal, of Sofala, of Monomotapa, of Mosambique, of Melinda: the blacks of Madagascar, and of the neighbouring islands, are likewise Caffres, and not Negroes. These two races of men have a greater resemblance to each other in colour than in their features, hair, skin, or smell: their manners and natural dispositions are likewise very different.

On a closer examination of the different people of which each of these races consist, we shall find as many varieties among the blacks as among the whites, and an equal number of shades from brown to black, as we have found from brown to white in the other race.

We shall begin with the countries to the north of Senegal, and, proceeding along the coasts, we shall consider the different nations which have been recognized and described by travellers. In the first place, it is certain, that the natives of the Canary islands are not Negroes; for we are assured by voyagers, that the

ancient inhabitants of these islands were tall, well made, and of a vigorous complexion; that the women were beautiful, and had fine hair; and that the inhabitants of the southern parts of each island were more olive than those on the northern parts. Duret, in the history of his voyage to Lima, informs us, that the ancient inhabitants of the island of Teneriffe were tall and robust, but meagre and tawny, and that most of them had flat noses. These people, we see, had nothing in common with the Negroes, except the flat nose. The natives of Africa, in the same latitude with these islands, are Moors, and very tawny; but like the islanders, they evidently belong to the race of whites.

The inhabitants of Cape Blanc are Moors, and follow the religion of Mahomet. Like the Arabs, they wander about from place to place, pasturing their horses, camels, oxen, goats, and sheep. They trade with the Negroes, who give them eight or ten slaves for a horse, and two or three for a camel. It is from these Moors that we have the gum Arabic, which they dissolve among their milk. They seldom eat flesh, and never kill their cattle, but when they are about to die of old age or disease.

The Moors are separated from the Negroes by the river Senegal. They are only tawny, and live on the north side of this river; but the Negroes who inhabit the south side of it are absolutely black. The Moors wander through the country; but the Negroes are sedentary, and dwell in villages. The former are free and independent; the latter are the slaves of tyrants who oppress them. The Moors are small, meagre, and have a pusillanimous aspect; but they are sly and ingenious. The Negroes, on the contrary, are large, plump, and well made, but they are simple and stupid. In fine, the country inhabited by the Moors consists of barren sands, where verdure appears only in very few places. But the Negro country is rich, fertile in pasture, and produces millet, and trees which are always green, but few of them bear fruit fit for food.

In some places, both on the north and south of the river Senegal, there is a species of men called Foulies, who seem to form the shade between the Moors and Negroes, and who are perhaps Mulattoes, produced by a mixture of the two nations. These Foulies are not entirely black, like the Negroes; but they are much browner than the Moors, and hold the middle rank between the two. They are likewise more advanced in civilization than the Negroes; they follow the religion of Mahomet, and are hospitable to strangers.

The Cape de Verd islands are peopled with Mulattoes, sprung from the Portuguese who first settled there, and the Negroes whom they found on these islands. They are called Copper-coloured Negroes, because, though they resemble the Negroes in their features, they are less black, or rather yellowish. They are handsome and ingenious, but extremely indolent and idle. They live chiefly by hunting and fishing. They train their dogs to kill the wild goats, with which the islands abound. They deliver their wives and daughters to the embraces of strangers, if they choose to pay for this singular favour. For pins and other trifles, they sell paroquets, porcelain-shells, ambergris, &c.

The first genuine Negroes we meet with are those on the southern banks of the Senegal. These people, as well as those who inhabit the country comprehended between this river and that of Gambia, call themselves Jaloffs. They are very black, handsome, of a fine stature, and their features are not so disagreeable as those of the other Negroes. Some of them, and particularly the women, have very regular features. They have the same ideas of beauty with the Europeans; for they are fond of fine eyes, a small mouth, thin lips, and a well proportioned nose: they differ only with regard to the basis of the picture, a very black shining colour being absolutely necessary to form a beauty: their skin is very fine and soft; and, abstracting from colour, they have as beautiful women as are to be met with in any other country in the world. Their females are generally handsome, gay, active, and extremely amorous; they are peculiarly fond of white men, whom they caress with ardour, both to satisfy themselves, and in hopes of obtaining presents. In their attachment to strangers, they meet with no restraint from their husbands. But though they offer their wives, daughters, and sisters, to strangers, and conceive their honour to be injured by a refusal, their jealousy rises to such a pitch, when their wives transgress with men of their own nation, that they often beat, and even cut themselves with sabres. Those women notwithstanding have the tobacco-pipe perpetually in their mouths, and their skin, when they are heated has a disagreeable smell, though it is not so strong as that of the other Negroes. They love dancing to the sound of the drum and calabash. All their movements in these dances consist of lascivious and indecent postures. They bathe often, and file their teeth in order to render them more equal. Most of the young girls engrave figures of animals, flowers, &c. on their skin.

It is a general practice among the Negro women, when travelling, to carry their children on their backs. Some have ascribed the flat nose and big bellies of the Negroes to this cause: the mother, in raising the child by sudden jerks, makes the child's nose strike against her back; and the child, to avoid these frequent blows, keeps its head as far back as possible, by pushing its belly forward. Their hair is black and crisp, like curled wool. It is by the hair and colour that they chiefly differ from other men; for their features are not perhaps so different from those of the Europeans as the Tartarian visage differs from that of a Frenchman. Father Tertre affirms, that if most of the Negroes are flat nosed, it is owing to

a general practice of the mothers, who depress the noses of their children as soon as they come into the world, and squeeze their lips to make them thick; and that those children who chance to escape these operations, have elevated noses, thin lips, and as fine features as the Europeans. This remark however is only applicable to the Negroes of Senegal, who are the most handsome and most beautiful of all the race. Among all the other Negroes, flat noses and thick lips seem to be features bestowed on them by nature; these, instead of deformities, are regarded as marks of beauty, and supplied by art, when they happen to be denied by nature.

The Negro women are extremely prolific: they bring forth their children with great ease, and require no assistance. Their labours are followed by no troublesome consequences; for their strength is fully restored by a day, or at most, two days repose. They make excellent nurses, and manage their children with great tenderness and affection. They are also more lively and alert than the men; and they even cultivate the virtues of discretion and temperance. Father Jaric informs us, that the Jaloff Negro women, in order to accustom themselves to eat and speak little, fill their mouths with water in the morning, and keep it there till the hour of breakfast.

The Negroes of the island of Goree, and of the Cape de Verd coast, like those on the banks of the Senegal, are well made and extremely black. They are so fond of a black shining complexion, that they despise such as want this perfection, in the same manner as tawny men are despised by the Europeans. Though strong and robust, they are exceedingly indolent, and cultivate neither corn, wines, nor fruits. Fish and millet are their chief articles of food; and they seldom eat flesh. They compare the Europeans to horses, because they eat herbs. But they are so passionately fond of spirits, that they sell their children, their parents, and even themselves, for brandy. They go almost naked, having only a cotton garment which covers them from the middle to about one half of the thigh; and they alledge that the heat of the climate permits them not to wear any more. Their poverty and bad cheer however hinder them not from being both fat and contented. They believe their country to be the finest in the universe; and that they are the handsomest men in the world, because they are the blackest: if their women betrayed no attachment to white men, their colour would give them no uneasiness.

Though the negroes of Sierra-Leona be not altogether so black as those of Senegal, they are not however, as Struys alledges, of a reddish or tawny colour. Like the Guinea Negroes, they are of a black less deep than the natives of Senegal. The general custom, among the negroes of Guinea, and Sierra-Leona, of painting their bodies with red and other colours, might deceive Struys. They likewise paint a ring round their eyes with white, yellow, or red, and make rays of different colours upon their faces; and many of them cut upon their skin figures of plants and of animals. Their women are still more debauched than those of Senegal. Many of them are common prostitutes, without incurring the smallest dishonour. Both men and women keep their heads uncovered; and they shave or cut their hair, which is very short, in various modes. They wear ear-rings made of teeth, shells, horns, bits of wood, &c. which weigh three or four ounces. Some of them pierce their nostrils or their upper lip, for the purpose of suspending similar ornaments. Their garments consist of a kind of apron made of the bark of a tree, covered with apes' skins; and to these skins they fix small bells. They sleep upon bull-rush mats; they eat fish or flesh when they can procure it; but yams and bananas are their principal food. They have no passion but for their women, and no inclination to activity or labour. Their houses are wretched huts. They often continue to live in wild and barren places, though in the neighbourhood of rich valleys, hills covered with trees, green and fertile fields, intersected in the most delightful manner with rivers and brooks. But their indolence and stupidity make them insensible to every pleasure of this nature. The roads which lead from one place to another are generally twice as long as they ought; but they attempt not to render them shorter; and, though the means were pointed out to them, they never think of taking the shortest road, but mechanically follow the beaten track, and are not anxious about losing time, which they have no mode of measuring.

Though the Guinea Negroes enjoy good health and have vigorous constitutions, they seldom reach old age. A Negro of 50 years is a very old man. Their premature commerce with the women is perhaps the cause of the brevity of their lives. Their children, when very young, are allowed to commit every species of debauchery, and nothing is so rare among these people as to find a girl who can remember the time when she ceased to be a virgin.

The islands of St. Thomas, of Annobona, &c. are inhabited by Negroes similar to those on the neighbouring continent; but their numbers are few; because the Europeans have chased them off, and retained only such as they reduced to slavery. Both men and women go naked, except a small apron round their middle. Mandelslo alledges that the Europeans who settle in the island of St. Thomas, which is but a degree and a half from the Equator, preserve their whiteness till the third generation; and he seems to insinuate that they turn black after that period. But it is not probable that this change can be so suddenly effected.

The Negroes on the coasts of Juda and Arada are less black than those of Senegal, Guinea, and Congo. They prefer the flesh of dogs to all other meat, a roasted

dog being generally the first dish presented at their feasts. This taste is not peculiar to the Negroes; the savages of North America, and some Tartarian nations, are equally fond of dog's flesh. The Tartars are even said to castrate dogs, in order to fatten them and improve their flesh.

Pigafetta, and Drake, who seems to copy him verbatim, inform us, that the Negroes of Congo are black, but less so than those of Senegal. Their hair is generally black and crisped, though in some it is red. The men are of a middle stature; in some, the eyes are brown; in others, they are of a sea-green colour. Their lips are not so thick as those of the other Negroes; and their features very much resemble those of the Europeans.

In certain provinces of Congo, they have very singular customs. When a person dies in Loango, for example, they place the corpse on a kind of amphitheatre, raised about six feet above the ground, and in a sitting posture, with the hands resting on the knees. They dress him in his best garments, and then kindle fires all round the body. In proportion as the clothes absorb the moisture, they cover him with fresh garments, till the body be perfectly dry; after which they bury him with great pomp. In the province of Malimba, the wife ennobles the husband. When the king dies and leaves only a single daughter, if she has arrived at the age of puberty, she becomes absolute mistress of the kingdom. She begins her reign by making a tour round her dominions. In all the towns and villages through which she passes, the whole men are obliged to appear before her, immediately upon her arrival, and she chooses the man whom she fancies most to pass the night with her. At her return from her journey, she sends for the man who has been so fortunate as to please her best, and instantly marries him. After marriage her power terminates, and devolves entirely on her husband. These facts I have extracted from M. de la Brosse's travels along the coast of Angola in the year 1738. He adds a fact not less singular. 'These Negroes,' says he, 'are extremely 'vindictive, of which I shall give a convincing proof. 'They daily demanded of us some brandy for the use of 'the King and chief men of the town. One day this 'request was denied, and we had soon reason to repent 'it; for all the French and English officers having gone 'a fishing on a small lake near the sea-coast, they erected 'a tent for the purpose of dressing and eating the fish 'they had caught. When they were amusing themselves 'after their repast, seven or eight Negroes, who were 'the chiefs of Loango, arrived in sedans, and presented 'their hands, according to the custom of the country. 'These Negroes privately rubbed the officers hands with 'a subtile poison, which acts instantaneously; and, ac 'cordingly, five captains and three surgeons, died on the 'spot, &c.

When the Negroes of Congo have a pain in their head, or any other place of the body, they make a small wound in the place affected, and apply to it a small horn with a hole in its middle, by means of which they suck out the blood till the pain abates.

The Negroes of Senegal, of Gambia, of Cape de Verd, of Angola, and of Congo, are of a finer black than those of the coasts of Juda, Issigni, Arada, and the adjacent provinces. When in health, they are all black; but, when sick, they become yellowish, or copper coloured. In the French islands, the Negroes of Angola are preferred, for their strength, to those of Cape de Verd: but, when heated, they smell so rank, that the places they pass through are infected with the stench for more than a quarter of an hour. The Cape de Verd Negroes do not smell so strong as those of Angola: they have also a finer and blacker skin; they are better made; their features are softer; their dispositions are more gentle, and their stature is more commodious. The Negroe of Guinea are very proper for cultivating the ground and other laborious offices. Those of Senegal are not so strong; but they are more ingenious, and better adapted for domestic services. Father Charlevoix tells us, that the Senegal Negroes are the most handsome, most docile, and best suited for domestic uses; that the Bambaras are larger, but that they are all rogues; that the Aradas are best acquainted with the culture of the earth; that the Congos are the smallest in size, and excellent fishers, but that they are much addicted to desertion; that the Nagos are the most humane, the Mondogos the most cruel, the Mimes the most resolute, most capricious, and most subject to despair; and that the Creole Negroes, from whatever nations they derive their origin, retain nothing of their parents but the colour and the spirit of slavery. They are more ingenious, rational, and dexterous, but more slothful and debauched, than the African Negroes. He adds, that the genius of all the Guinea Negroes is extremely limited; that some of them appear to be perfectly stupid, not being able to count beyond the number of three; that they never think spontaneously; that they have no memory, the past and the future being equally unknown to them; that the most sprightly of them have some humour, and make tolerable mimics; that they are extremely cunning, and would rather die than tell a secret; that, in general, they are gentle, humane, docile, simple, credulous, and even superstitious; and that they are faithful and brave, and, if properly disciplined, would make good soldiers.

Though the Negroes have little genius, their feelings are extremely acute. According to the manner they are treated, they are gay or melancholy, laborious or slothful, friends or enemies. When well fed, and not maltreated, they are contented, joyous, ready for every employment, and the satisfaction of their mind is painted in their countenance. But, when oppressed and abused,

they grow peevish, and often die of melancholy. Of benefits and of abuse, they are extremely sensible, and against those who injure them they bear a mortal hatred. On the other hand, when they contract an affection to a master, there is no office, however hazardous, which they will not boldly execute, to demonstrate their zeal and attachment. They are naturally affectionate, and have an ardent love to their children, friends, and countrymen. The little they possess they freely distribute among the necessitous, without any other motive than that of pure compassion for the indigent.

Upon the whole, it is apparent, that the unfortunate Negroes are endowed with excellent hearts, and possess the seeds of every human virtue. I cannot write their history, without lamenting their miserable condition. Is it not more than enough to reduce men to slavery, and to oblige them to labour perpetually, without the capacity of acquiring property? to these, is it necessary to add cruelty, and blows, and to abuse them worse than brutes? humanity revolts against those odious oppressions which result from avarice, and which would have been daily renewed, had not the laws given a friendly check to the brutality of masters, and fixed limits to the sufferings of their slaves. They are forced to labour; and yet the coarsest food is dealt out to them with a sparing hand. They support, say their obdurate taskmasters, hunger without inconvenience; a single European meal is sufficient provision to a Negro for three days; however little they eat or sleep, they are always equally strong, and equally fit for labour. How can men, in whose breasts a single spark of humanity remains unextinguished, adopt such detestable maxims? How dare they, by such barbarous and diabolical arguments, attempt to palliate those oppressions which originate solely from their thirst of gold? but let us abandon those hardened monsters to perpetual infamy, and return to our subject.

Of the inhabitants of the coasts and of the interior parts of Africa, from Cape Negro to Cape de Voltes, an extent of about 400 leagues, we have no knowledge. We only know, that these men are less black than the other Negroes, and that they resemble the Hottentots, with whom they border on the south. The Hottentots, on the contrary, are well known, and described by almost every voyager. They are not Negroes, but Caffres, and would be of a tawny colour only, if they did not blacken their skin with grease and paint. M. Kolbe, who has given a very accurate description of these people, regards them, however, as Negroes. He assures us, that they have all short, black, frizzled, woolly hair; and that he never saw a single Hottentot with long hair. But this circumstance is not sufficient to make us consider them as genuine Negroes. In the first place, their colour is totally different; for M. Kolbe tells us, that they are olive, and never black, though they employ every method to darken their skin. In the next place, it seems to be equally difficult to pronounce concerning their hair; for they never either comb or wash it, but daily rub on their heads vast quantities of grease, soot, and dust, which make their hair resemble a fleece of wool stuffed with dirt. Besides, their dispositions are different from those of the Negroes. The latter are sedentary, love cleanliness, and are easily reconciled to servitude. The Hottentots, on the contrary, are a wandering, independent people, extremely jealous of their liberty. These differences are more than sufficient to convince us that the Hottentots are not of the same race with the Negroes.

Gama, who first doubled the Cape of Good Hope, arrived in the bay of St. Helena on the 4th of November, 1497. He describes the inhabitants as being black, of small stature, and having a very disagreeable aspect: but he says not that they were naturally black like the Negroes; and, doubtless, they only seemed black to him by the grease and soot with which they are perpetually covered. This voyager adds, that the sound of their voice resembled sighing; that they were clothed in the skins of beasts; and that their arms were bludgeons hardened with the fire, and pointed with the horn of some animal. It is apparent, therefore, that the Hottentots practise no arts in common with the Negroes.

We are informed by the Dutch voyagers, that the savages to the north of the Cape are smaller than the Europeans; that their colour is a reddish brown; that they are extremely ugly, and endeavour to increase their blackness with paint; and that their hair resembles that of a man who has hung long on a gibbet. In another place, they tell us, that the Hottentots are of the colour of Mulattoes; that their visage is greatly deformed; that they are of a middle size, but meagre, and exceedingly nimble in the chase; and that their language resembles the clucking of a Turkey-cock. Father Tachard says, that though in general their hair be woolly like that of the Negroes, yet many of them have long hair, which floats upon their shoulders. He even adds, that some of them are as white as Europeans, but that they blacken their skin with grease, and the powder of a certain black stone; and that their women are naturally fair; but, to please their husbands, they paint themselves black. Ovington tells us, that the Hottentots are more tawny than the other Indians; that no people resemble the Negroes more in colour and features, but that they are not so black; and their hair is not so crisped, nor their nose so flat.

From all these testimonies it is plain that the Hottentots are not true Negroes, but blacks beginning to approach towards whiteness, as the Moors are whites approaching to blackness. These Hottentots, moreover, are a very singular species of savages. Their women,

who are commonly much less than the men, have a kind of excrescence, or hard broad skin, which originates above the os pubis, and descends, like an apron, to the middle of their thighs. Thevenot says the same thing of the Egyptian women, but that, instead of allowing this excrescence to grow, they burn it off with hot irons. With regard to the women of Egypt, the fact is very doubtful. But it is certain, that all the women who are natives of the Cape are subject to this monstrous deformity, which they uncover to those who have the curiosity to look at it. The men are all half eunuchs, not naturally, but by an absurd custom of cutting out one of the testicles about the age of eight years. M. Kolbe saw this operation performed on a young Hottentot. The circumstances with which this ceremony is accompanied are so singular that they deserve to be recited.

After rubbing the young man with grease taken from the entrails of a sheep which is slain for the purpose, they lay him on his back on the ground, tie his hands and his feet, and three or four of his friends hold him. Then the priest (for it is a religious rite), armed with a sharp knife, makes an incision, and cuts away the left testicle, and puts in its place a ball of grease of the same size, prepared with some medicinal herbs. He then sews up the wound with the bone of a small bird, which serves for a needle, and a thread made of the tendon of a sheep. The operation being thus finished, the patient is untied. But the priest, before quitting him, rubs him all over with the warm grease of a new-killed sheep, or rather pours the grease upon him so copiously, that, when cool, it forms a kind of crust. At the same time he rubs him so roughly, that the young man, who has already suffered too much, is covered with sweat, and fumes like a capon on a spit. The operator next makes furrows with his nails in this crust of grease, from one end of the body to another. After which he again rubs the patient, and fills up the furrows with fresh grease. The young man is now instantly abandoned, and left alone in a condition rather resembling death than life. He is obliged to crawl, in the best manner he can, into a hut purposely erected near the place where the operation is performed. There he either perishes or recovers, without assistance, or any other nourishment than the grease that covers him, and which he may lick, if he chooses. At the end of two days he generally recovers, comes out of his hut, and presents himself to his friends; and to prove that he is perfectly cured, he runs before them with the swiftness of a stag.

All the Hottentots have broad flat noses, which would not be the case, if their mothers did not flatten them immediately after birth; for they regard a prominent nose as a great deformity. They have also very thick lips, white teeth, bushy eye-brows, large heads, meagre bodies, and small limbs. They seldom live above 40 years. The short duration of their lives is unquestionably occasioned by the nastiness in which they perpetually wallow, and the putrid flesh on which they chiefly feed. As most travellers have written fully concerning the manners of this dirty people, I shall only add one fact more, which is related by Tavernier. The Dutch, says he, carried off a Hottentot girl a few days after her birth, brought her up among themselves, and she soon became as white as any European. From this fact, he concludes, that all the Hottentots would be equally fair, if they did not perpetually daub themselves with dirt and black paints.

Along the African coast, beyond the Cape of Good Hope, we meet with the territory of Natal, the inhabitants of which differ greatly from the Hottentots. They are better made and less ugly. They are likewise naturally blacker; their visage is oval, their nose well proportioned, and their teeth are white; their aspect is agreeable, and their hair is naturally crisped. But, like the Hottentots, they have some taste for grease; for they wear bonnets made of the tallow of oxen. These bonnets are from eight to ten inches high, and they spend a good deal of time in preparing them: for this purpose the tallow must be well refined; they apply but little of it at a time, and mingle it so completely with their hair, that it never falls off. M. Kolbe alledges, that their noses are flat from their birth, and that they use no arts to flatten them; that they do not stammer, or strike the palate with the tongue, like the Hottentots; that they build houses, cultivate the ground, and sow a species of maise or Turkish corn, of which they make ale, a drink unknown to the Hottentots.

Beyond the territory of Natal, we meet with those of Sofala and Monomotapa. According to Pigafetta, the people of Sofala are black, but taller and thicker than the other Caffres. This author places the Amazones in the neighbourhood of the kingdom of Sofala. But nothing can be more uncertain than what has been affirmed with regard to those female warriors. The natives of Monomotapa, say the Dutch travellers, are tall, handsome, black, and have fine complexions. The young girls go naked, wearing only a thin piece of cotton stuff upon their middle; but put on garments as soon as they get husbands. These people, though very black, are different from the Negroes. Their features are neither so coarse nor so ugly; their bodies have no bad smell; and they can neither support servitude nor hard labour. Father Charlevoix tells us, that he has seen blacks of Monomotapa and Madagascar in America; but that they could never be trained to labour, and soon perished.

The natives of Madagascar and of Mosambique are more or less black. The inhabitants of Madagascar have the hair on the crown of their heads not so much crisped as those of Mosambique. Neither of them are true Negroes; and though those on the coast are very submissive to the Portuguese, the people in the interior

parts of the continent are extremely savage, and jealous of their liberty. Both men and women go perfectly naked; they eat the flesh of elephants, and sell the ivory to strangers. Madagascar is chiefly inhabited by blacks and whites, who though very tawny seem to be a different race of men. The hair of the former is black and crisped; that of the latter is fairer, less frizzled, and longer. It is a common opinion, that these whites derive their origin from the Chinese. But Francis Cauche properly remarks, that they seem to be of European extraction; for he assures us, that all of them he saw had neither flat faces nor noses like the Chinese. He likewise says, that these whites are fairer than the Castilians; that their hair is long; that the blacks are not flat-nosed like those on the continent; and that their lips are thin. In this island there are also many persons of an olive or tawny colour, who probably proceed from a mixture of the blacks and whites. The same traveller informs us, that the inhabitants round the bay of St. Augustine are tawny; that they have no beard; that their hair is long and smooth; that they are tall and handsome; and, lastly, that they are all circumcised, though they probably never heard of the law of Mahomet, for they have neither temples, mosques, nor religion. The French first landed and established a settlement on this island; but the settlement was not supported. When they arrived, they found the white men above described; and they remarked, that the blacks had a great respect for these whites. The island of Madagascar is extremely populous, and abounds in cattle and pasturage. Both men and women are exceedingly debauched; and public prostitution is not followed with dishonour. They love dancing, singing, and similar amusements. Though indolent they have some knowledge of the mechanic arts; and though they have no moveables in their houses, but lie upon mats, they have husbandmen, smiths, carriers, potters, and even goldsmiths. They eat their meat almost raw, and devour the skins of their oxen, after singing the hair; they likewise eat the wax with the honey. The common people go almost naked; but the more opulent wear drawers or petticoats of cotton and silk.

The natives of the interior parts of Africa are too little known to admit of description. Those called Zingues by the Arabians, are black, and almost perfectly savage. Marmol tell us, that they multiply prodigiously, and would over-run the adjacent country if numbers of them were not swept off from time to time by a great mortality occasioned by hot winds.

Upon the whole, it appears that the Negroes are a different species of blacks from the Caffres. But from the descriptions we have given, it is still more apparent, that the differences of colour are produced by the climate; and that the peculiarities in features depend much upon the customs which take place among different nations, such as flattening the nose, pulling the hair off the eye-brows, lengthening the ears, thickening the lips, making the face broad, &c. Nothing can be a stronger proof of the influence of climate upon colour, than to find, under the same latitude, and distant from each other more than 1000 leagues, people so similar as the Nubians and natives of Senegal; and to find, that the Hottentots, who must have originated from a black race, are the whitest people in Africa, for no other reason but because their country is the coldest. If the tawny nation on one side of the river Senegal, and the perfect blacks on the other, occur as an objection, I must refer to what was above remarked concerning the effects of food, which has a great influence on colour, as well as many other customs and modes of living; and if an example be demanded, I shall produce one from the brute creation, which every man is in a condition to verify. The flesh of the hares that live in the plains and moist grounds is whiter than that of those which inhabit mountainous or dry regions; and even in the same part of the country, those which feed in the meadows are perfectly different from those that dwell on the hills. The colour of the flesh proceeds from that of the blood and other humours of the body, the qualities of which necessarily depend on the nature of the food.

The origin of black men has at all times been an object of inquiry. The ancients, who knew only those of Nubia, regarded them as the last or terminating shade of the tawny colour, and confounded them with the Ethiopians, and other African nations, who, though extremely brown, belong more to the white than to the black race. They thought that the differences of colour among the human species proceeded solely from the varieties of climate, and that blackness was occasioned by a perpetual exposure to the hot rays of the sun. This opinion, though very probable, was much weakened, after it was discovered that the inhabitants of more southern climates, and even under the Equator itself, as those of Melinda and Mosambique were not black, but very tawny; and when it was farther discovered, that blacks transported into more temperate climates, lost nothing of their original hue, but communicated it to their descendants. If we attend however to the migrations of different people, and to the time necessary to produce a change in their colour, we shall perhaps find the opinion of the ancients to have been well founded; for the natives of this part of Africa are Nubians, and will preserve their original blackness as long as they continue to live under the same climate, and mix not with the whites. But the Ethiopians, the Abyssinians, and even the natives of Melinda, though they derive their origin from the whites, their religion and customs being the same with those of the Arabians, are however more tawny than the inhabitants of the southern parts of Arabia. This circumstance alone evinces, that even among the

same race of men, the different degrees of blackness depend, more or less, upon the heat of the climate. Many ages are, perhaps, necessary to change the white colour into perfect blackness; but it is probable, that, in a succession of generations, a white people, transported from the north to the Equator, would undergo this change, especially if they adopted the manners, and used the food of the new country.

The objection drawn from the difference of features is not insurmountable; for the features of a Negro, who has not been purposely deformed in his infancy, differ not more from those of an European than a Tartar differs from a Chinese, or a Circassian from a Greek: and with regard to the hair, the nature of it depends so much on the quality of the skin, that any differences which take place in it ought to be considered as merely accidental; for, in the same country, and even in the same village, we find every possible variety of hair. In France, for example, there are some men whose hair is as short and as crisped as that of a Negro: besides, heat and cold have great influence upon the colour of the hair both of men and other animals. In the northern regions black hair is seldom or never seen: and squirrels, hares, weasels, and several other animals, are white in the north, but brown or gray in more southern latitudes. The effects produced by cold and heat are even so remarkable, that in Sweden certain animals, as the hares, are gray during the summer, and perfectly white in winter.

But the New World affording no examples of true Blacks, is the strongest argument against my hypothesis; and it appears, at first sight, to be almost insuperable. If blackness were the effect of heat alone, why do we not find Negroes or black men in the Antilles, in Mexico, in Santa-Fé, in Guiana, in the country of the Amazones, or in Peru; since these countries of America are situated under the same latitude with Senegal, Guinea, and Angola in Africa? if the different colours of the human species were occasioned by the climate, or the distance from the Pole, we should have found, in the Brazils, in Paraguay, or in Chili, men similar to the Caffres and Hottentots. But, before attempting to remove this objection, it is necessary to give a short description of the various American nations; after which we shall be the more qualified to make just comparisons, and to draw general conclusions.

In the most northerly regions of America, we find a species of Laplanders, similar to those of Europe, or to the Samoiedes of Asia. Though their numbers are few, they are spread over a large extent of country. Those who live round Davis's Straits are small, of an olive colour, and have short thick limbs. They are excellent fishers, and eat their meat and fish raw. Their drink is pure water, or the blood of the sea-dog. They are very robust, and long-lived. These are exactly the figure, colour, and manners of the Laplanders: and, what is singular, as the Fins, who are adjacent to the European Laplanders, are white, beautiful, and pretty large and handsome; so, in the neighbourhood of the American Laplanders, we find a species of men who are tall, handsome, pretty white, and possessed of very regular features. The savages along Hudson's Bay, and to the north of Labrador, though they are small, ill made, and ugly, appear not to be of the same race with the former. Their visage is almost entirely covered with hair, like the savages of the lands of Jesso, to the north of Japan. In summer they dwell in tents made of the skins of the rein-deer; and, in winter, they live under ground, like the Laplanders and Samoiedes, where they lie promiscuously, and without ceremony. Though their food consists only of raw flesh and fish, they live very long. The savages of Newfoundland resemble those of Davis's Straits. They are of small stature, have little or no beard, broad faces, large eyes, and generally flat noses. The traveller who gives this description adds, that they have a great similarity to the savages in the environs of Greenland.

To the south of these savages, who are spread over the northern regions of America, we meet with a different and more numerous race, who occupy Canada, and the adjacent territories, as far as the Assiniboils. They are large, strong, well made, and all of them have black hair, black eyes, very white teeth, a swarthy colour, little beard, and hardly any hair on their bodies. They are indefatigable in travelling, and extremely nimble in the chase. With equal ease they can support hunger, and the greatest excess in eating. They are hardy, bold, grave, and moderate: in a word, they have so strong a resemblance, both in their external appearance, and in their manners and dispositions, to the oriental Tartars, that, if they were not separated by a vast sea, we should believe them to have sprung from the same nation. They also live under the same latitude; which is a farther proof of the influence of climate upon the figure and colour of the human species. To conclude, in the northern extremities of the New Continent, as well as in those of the old, we first find men similar to the Laplanders, and likewise a race of whites with fair hair, like the inhabitants of the north of Europe; then hairy men resembling the savages of Jesso; and, lastly, the savages of Canada, who occupy the whole territory as far as the Gulf of Mexico, and so strongly resemble the Tartars, that, if there were no embarrassment concerning the possibility of their migration, we should conclude them to be the very same people. However, if we attend to the small number of men scattered over the immense territories of North America, and their universal want of civilization, we must admit that all these nations of savages have been peopled by the escape of individuals from some more numerous race. Though we should

allow the number of natives to be now reduced to a twentieth part of what they were on the first discovery of America, still this country was, even then, so thinly inhabited, that it must be considered as a desert, or a land so recently peopled, that the men had not time sufficient for an extensive multiplication. M. Fabry, who penetrated farther into the interior parts of this country, to the northwest of the Missisippi, than any other man had done, and where, of course, the savages could not have suffered any diminution by the inroads of the Europeans, assures us, that he often travelled in this region 200 leagues without seeing a human face, or any marks which indicated the adjacent country to be inhabited; and that, when he did meet with any Indian huts, they were always at least 100 leagues distant from each other, and seldom contained above 20 persons. Along the banks of rivers and lakes, it is true, the savages are more numerous, and some of them are even troublesome to our colonists. But these nations seldom exceed three or four thousand persons, and are spread over a country often more extensive than the kingdom of France: so that I am persuaded there are more men in Paris than all the natives of North America, from the Gulf of Mexico to the Northern Ocean, though this territory is much larger than Europe.

Population depends more on society than Nature. Men would not be comparatively so numerous as the savage animals, if they were not united, and derived not mutual aid and succour from society. In North America, the bisons are perhaps more abundant than the men. But, though population be a result of society, it is the increased number of men which necessarily produces their unity. We may therefore presume, that the want of civilization in America is owing to the paucity of its inhabitants; for, though each nation had peculiar customs and manners, though some were more savage, cruel, and dastardly than others; yet they were all equally stupid, ignorant, and destitute of arts and of industry.

I have run, perhaps, into too great a detail concerning the manners of savage nations. Most authors have mistaken the particular actions of individuals, which often result from caprice or unknown circumstances, for the general and established manners of a nation. Some people, they tell us, eat their enemies; others burn or maim them; some delight in war; others love peace. Some kill their parents after they arrive at a certain age; among others, the fathers and mothers eat their own children. These, and similar narrations, so much delighted in by travellers, are reducible to single facts, and import no more, than that one individual savage eat his enemy, another burnt or maimed him, and a third killed or eat his own child. All these examples may be found in every savage nation; for a people who live without the restraint of fixed laws, or of a regular government, can only be considered as a tumultuous assemblage of barbarous and independent individuals, who obey no laws but those of passion and caprice, and who, having no common interest, are incapable of pursuing any determined standard of manners, which supposes general views that have obtained the sanction both of time and a majority of numbers.

A nation, it may be said, is composed of men who are known to each other, who speak the same language, who unite, when necessary, under the same chief, who use the same arms, and who paint themselves with the same colours: to this we might subscribe, without difficulty, if these manners were constant and uniform; if the people did not often unite and separate without design; if their chief lost not all authority by their caprice or his own; and if their language was not so simple as to be almost common to every tribe.

As they have but few ideas, their expressions are limited to the most common objects; and, though every mode of expression should differ from another; yet the smallness of their number necessarily renders them of easy acquisition. It is not, therefore, so difficult for a savage to learn the language of all other savages, as for a polished man to learn the language of another people equally advanced in civilization.

But it is, perhaps, of more importance to examine the nature of the individual savage, than to enlarge upon the manners and customs of these pretended nations. Of all animals, a savage man is the most singular, the least known, and the most difficult to describe. We are so ill qualified to distinguish the genuine gifts of Nature from what is acquired by education, art, and imitation, that it would not be surprizing if we should totally mistake the real portrait of a savage, though the natural colouring and features of his character were faithfully represented to us.

An absolute savage, such as the boy brought up by the bear, described by Conor, the young man found in the forest of Hanover, or the girl discovered in the woods of France, would be a curious object to a philosopher, by the contemplation of which he might estimate the force of natural appetites: here he would see the mind perfectly naked; he might distinguish all its movements; he might perhaps discover in it more sweetness and tranquillity than in his own; he might, perhaps, clearly perceive, that virtue is more natural to the savage than to the civilized, and that vice derives its origin and support from society alone.

But to return to our subject: if North America affords only savages, Mexico and Peru present us with a polished people, governed by laws, and subject to regal establishments. They had industry, arts, and a species of religion. They dwelt in cities, where order and police were maintained by the authority of the sovereign. These people, who were very numerous, cannot be

considered as new nations, or as originating from individuals who had escaped from Europe or Asia, from whom they are so remote. Besides, if the savages of North America, because they are situated under the same latitude, resemble the Tartars, the people of Mexico and Peru, though like the Negroes they live under the Torrid Zone, have no similarity to them. What then is the origin of these people, and what cause can be assigned for the difference of colour in the human species, since the influence of climate is insufficient in this case to solve the phænomenon ?

Before answering these questions, we must continue our description of the savages of South America. Those of Florida, of the Missisippi, and of the more southerly regions, though not absolutely brown, are more tawny than the Canadians. The oil and paint with which they rub their bodies, render their colour unnaturally olive. Coreal tells us, that the women of Florida are tall, strong, and, like the men, of an olive colour ; that they paint their arms, limbs, and body, with several colours, which remain for ever, because they are engrained in the skin by means of puncturing ; that the olive colour of both sexes proceeds not so much from the heat of their climate, as from the oil with which they varnish the skin : he adds, that the women are extremely active ; that with an infant in their arms, they swim across large rivers ; and that with equal agility they climb the highest trees. All these qualities they possess in common with the Canadians and other savages of America. The author of the Natural and Moral History of the Antilles remarks, that the Apalachians, a people bordering on Florida, are tall, well-shaped, and of an olive colour ; and that they all have long black hair : he adds, that the Caribbees, who inhabit the Antilles, have sprung from the savages of Florida ; and that the time of their migration has been handed down by tradition.

The natives of the Lucai islands are less tawny than those of St. Domingo and Cuba. But so few of either now remain, that the relations of the first voyagers to these countries can derive no support from them. These people, it has been alledged, were very numerous ; that they were governed by a kind of chiefs called Caciques ; and that they had priests and physicians. But all this is problematical, and besides has no connection with our history. The Caribbees in general, says Father du Tertre, are tall, and have a pleasant aspect ; they are strong, robust, active, and healthy ; some of them have flat visages and depressed noses : these features however are not natural to them, but artificially induced by their parents soon after birth. This capricious practice of altering the natural figure of the head is very general among savage nations. Most of the Caribbees have small black eyes, white teeth, and long, smooth, black hair. Their colour is tawny or olive ; and this colour is natural to them, and not the effect of painting, as some authors have maintained ; for the colour of such of their children as have been trained up among Europeans, and not allowed the use of paint, was precisely the same with that of their parents. All these savages, though they never think, have a pensive melancholy aspect. Though cruel to their enemies, they are naturally mild and compassionate. They marry indifferently, either their own mothers or strangers. Their cousins-german belong to them by law ; and several of them have been known to possess at the same time two sisters, or the mother and the daughter, and even their own daughter. Those who have several wives visit them alternately for a month, or a stated number of days, which extinguishes jealousy among the women. They easily pardon adultery in their wives ; but they never forgive him who debauches them. They feed upon crabs, turtles, lizards, serpents, and fishes, which they season with pimento and the flour of manioc. Being extremely indolent, and accustomed to the most unbounded independence, they detest servitude, and never can be trained to labour like the Negroes. To preserve their liberty, they exert every effort ; and when they find it impracticable, they, rather than work, choose to die of hunger or of chagrin. The Arrouaguas, who are milder than the Caribbees, are sometimes employed ; but it is only in fishing or hunting, exercises of which they are naturally fond, and to which they have been accustomed in their own country. If these savages are to be retained as slaves, they must be treated with as much gentleness as domestic servants, otherwise they will desert, or perish with melancholy. The Brasilian slaves have nearly the same disposition, though they seem to be less stupid, indolent, and melancholy than any other American savages. However, when treated with gentleness, they may be trained to any operation, except that of cultivating the ground, which they consider as the characteristic badge of slavery.

Savage women are always smaller than the men. The Caribbee females are fat, and tolerably handsome. Their hair and eyes are black ; their visage is round, their mouth small, their teeth white ; their air is more open, gay, and lively, than that of the men ; and they are modest and reserved. They daub themselves with paint ; but they do not use the black strokes upon the face and other parts of the body, as is customary with the men. They wear only a small apron made of cotton, studded with beads, about eight or ten inches broad, by five or six long. This stuff they purchase of the Europeans ; and beside the apron, they use collars of the same cloth round their necks, which hang down upon their bosoms. They likewise wear bracelets of this stuff on their wrists and arms, and ear-rings made of a blue stone, or of strings of beads. The last ornament peculiar to the women is a kind of buskin of cotton studded with beads, which extends from the ankle to the calf of the leg. As soon as the girls arrive at the age of puberty, they are

furnished with an apron and buskins, the latter of which are made so tight, that they cannot be removed; and as they prevent the under part of the leg from thickening, the upper parts grow larger and stronger than they would naturally do.

The inhabitants of Mexico and Peru are so mixed, that it is difficult to find two faces of the same colour. In the town of Mexico, there are Europeans, Indians from North and South America, African Negroes, Mulattoes, and mongrels of every kind; so that we see men there of every shade between black and white. The natives of the country are brown or olive, well-made, and nimble. They have little hair, even on their eye-brows; but that on their head is very long and very black.

The natives of the isthmus of America are, as Wafer remarks, generally of a good stature and shape. They have elegant limbs, a full chest, and are extremely active and fleet in the chase. The women are little and squat; and though when young, they are jolly and have brilliant eyes; yet they possess not equal vivacity with the men. Both men and women have round faces, short flat noses, large eyes, mostly of a grey colour, and full of fire, high foreheads, white teeth, thin lips, mouths of a middle size, and in general a very regular set of features. They all have long, black, straight hair; and the men would have beards, if they did not pull out the hairs. Their colour is tawny; and their eye-brows are as black as jet.

But these are not the only natives of this isthmus; for we find among them a species of white men, whose colour resembles not that of the Europeans, but their whiteness is similar to that of milk, or to the hairs of a white horse. Their skin is covered with a kind of short white down, which is not so thick upon the cheeks and forehead as to conceal the skin. Their eye-brows are perfectly white, as well as their hair, which is seven or eight inches long, and half crisped. These Indians are not so tall as the others; and, what is singular, their eye-lids are oblong, or rather in the form of a crescent, with the points turned down. Their eyes are so weak, that they can hardly see any object during the day: they cannot suffer the rays of the sun, and have no distinct vision but from the light of the moon. Their complexion is extremely delicate; they have an abhorrence at all hard labour; they sleep during the day, and never go abroad but in the night. When the moon shines, they run through the deepest shades of the forests with as much freedom and nimbleness as other men do in the clearest day. Upon the whole these men are neither so robust nor vigorous as the other Indians: they form a peculiar and distinct race. But it sometimes happens, that a husband and wife, though both of a copper colour, produce one of these white children. Wafer, from whom I have transcribed these facts, tells us, that he has seen a child of this kind before it was a year old.

If this fact be true, the singular colour and constitution of these white Indians would be only a species of disease which they derive from their parents. But if these white Indians are not produced by those of a copper colour, but form a distinct race, then they resemble the Chacrelas of Java, and the Bedas of Ceylon, which I formerly described. If however these white people actually proceed from copper-coloured parents, we must allow that the Chacrelas and Bedas have also been produced by tawny progenitors, and that all white men, whom we find at such great distances from each other, form not a particular race, but are only individuals who have accidentally degenerated from their original stock.

This last opinion, I acknowledge, seems to be the most probable; and if voyagers had given us descriptions of the Bedas and Chacrelas equally exact with what Wafer has given of the Dariens, we should perhaps have been satisfied that they are not, any more than the latter, of European extraction. The production of whites by Negro parents, which sometimes happens, adds great force to this theory. In the history of the Freneh Academy, we have descriptions of two of these white Negroes. I have seen one of them myself, and I am assured, that they are very frequent among the Negroes of Africa. What I have seen, independent of the relations of voyagers, leaves me no room to doubt concerning the origin of these white Negroes: they are only Negroes who have degenerated from their race, and not a particular and permanent species of men: in a word, they are among the Negroes what Wafer tells us the white Indians are among the yellow or copper-coloured Indians of Darien, and probably what the Chacrelas and Bedas are among the brown Indians of the East. It is singular that this variation of nature takes place from black to white only, and not from white to black. It is no less singular, that all the people in the East Indies, in Africa, and in America, where these white men appear, lie under the same latitude: the isthmus of Darien, the Negro country, and the island of Ceylon, are under the very same parallel. White then appears to be the primitive colour of nature, which may be varied by climate, by food, and by manners, to yellow, brown, and black, and which, in certain circumstances, returns, but so greatly altered, that it has no resemblance to the original whiteness, because it has been adulterated by the causes which have already been assigned.

Upon the whole the two extremes continually approach each other. Nature, in her most perfect exertions, made men white; and the same nature, after suffering every possible change, still renders them white: but the natural or specific whiteness is very different from the individual or accidental. Of this we have examples in

vegetables, as well as in men and other animals. A white rose is very different, even in the quality of whiteness, from a red rose, which has been rendered white by the autumnal frosts.

A still farther proof that those white men are only degenerated individuals, may be drawn from their comparative weakness of constitution, and from the extreme feebleness of their eyes. This last fact will appear to be less singular, when we reflect, that, in Europe, very fair men have generally weak eyes; and I have remarked that their organs of hearing are often dull. Nay, it is even alledged, that dogs of a perfect white colour are deaf: whether this be generally the case, I know not; but I have found it to be true in several instances.

Like the natives of the Isthmus, the Indians of Peru are of a copper-colour, especially those who dwell in the plains and along the sea-coast; for those who live in the elevated parts of the country, as between the two chains of the Cordeliers, are nearly as white as the Europeans. Some parts of Peru are a league higher than others, which, with regard to the temperature of the climate, produces a greater change than an hundred leagues of latitude. All the Indians in Guiana and along the river of the Amazones are more or less of a reddish tawny colour. The difference of shades, says M. de la Condamine, is chiefly owing to the temperature of the air, which varies from the extreme heat of the Torrid Zone to the great colds occasioned by the neighbourhood of the snow. Some of these savages, as the Omaguas, flatten the visages of their children, by lacing their heads between two boards. Others pierce the nostrils, lips, or cheeks, in order to fix in them the bones of fishes, feathers, and other ornaments. Most of them pierce their ears, and use flowers and herbs in place of ear-rings. Concerning the Amazones, I shall be entirely silent. The reader may consult writers upon this subject; and, after perusing them, he will not discover evidence sufficient to prove the existence of this race of females.

Some voyagers mention a nation in Guiana, of which the natives are blacker than any other Indians. The Arras, says Raleigh, are nearly as black as the Negroes, are extremely strong, and use poisoned arrows. This author speaks likewise of another nation of Indians, whose necks are so short, and shoulders so elevated, that their eyes seem to be upon their shoulders, and their mouths in their breast. This monstrous deformity cannot be natural: it is not improbable that savages, who delight in disfiguring Nature by flattening, rounding, or lengthening the heads of their children, should likewise conceive the fancy of sinking their heads between their shoulders. To give rise to such absurd caprices, nothing farther was necessary than the idea that deformity rendered them more terrible to their enemies. The Scythians, who were formerly as savage as the present American Indians, entertained the same notions, and practised the same ridiculous arts, which unquestionably gave rise to what the ancients have written concerning men without heads, men with dog's heads, &c.

The savages of Brazil are nearly of the same size with the Europeans; but they are stronger, more robust, and more nimble: neither are they subject to so many diseases; and they live very long. Their hair, which is black, rarely grows hoary with age. Their colour is tawny, being a mixture of brown and red. They have large heads, broad shoulders, and long hair. They pull the hairs out of their beards, their eye-brows, and every other part of their bodies, which gives them an uncommon and fierce aspect. They pierce their under lip for the purpose of inserting a small bone polished like ivory, or a green stone. The mothers flatten the noses of their children immediately after birth. They all go absolutely naked, and paint their bodies with various colours. Those of them who lie on the sea-coasts are now a little civilized by the trade they carry on with the Portuguese; but most of those who inhabit the interior parts of the country are still absolute savages. It is not by force and by slavery that savages are civilized: the missionaries have polished more men in these savage nations than the arms of those princes who subdued them. It was in this manner that Paraguay was conquered. The natural ferocity and stubbornness of these savages were overcome by the gentleness, humanity, and venerable example of the missionaries. They often spontaneously solicited to be instructed in that law which rendered men so perfect; and they frequently submitted to its precepts, and united with society. Nothing can reflect greater honour on religion than the civilizing of these nations of barbarians, and laying the foundations of an empire, without employing any other arms but those of virtue and humanity.

The inhabitants of Paraguay are, in general, pretty tall, and well shaped: their visage is long, and their skin of an olive colour. They are sometimes affected with an extraordinary disease: it is a species of leprosy, which forms a crust over the whole body, resembling the scales of fishes; but it neither occasions pain, nor does any injury to their constitution.

Like the Peruvians, the Indians of Chili, according to Frezier, are of a tawny colour, resembling reddish copper. This colour is different from that of the Mulattoes, who, as they are produced by a white man and a Negro woman, or a white woman and a Negro man, are of a brown colour, or a mixture of black and white. The Indians of South America, on the contrary, are yellow, or rather reddish. The natives of Chili are of a good size; they have thick limbs, a large chest, a disagreeable visage, small eyes, long ears, and straight, bushy, black hair. They lengthen their ears, and pull out their

beard with pinchers made of shells. Though the climate be cold, most of them go naked, except a skin thrown over their shoulders. At the extremity of Chili, and on the confines of Terra Magellanica, a gigantic race of men have, it is alledged, been lately discovered. Frezier informs us, on the authority of several Spaniards, who pretended to be eye-witnesses, that these men are nine or ten feet high. These giants, he remarks, are called Patagonians, and inhabit the eastern parts of the desert coast mentioned in ancient voyages: the story of the Patagonians was afterwards regarded as perfectly fabulous; because the Indians discovered along the Straits of Magellan surpassed not the ordinary stature of men. It is this circumstance, he continues, that might deceive Froger in his account of the voyage of M. de Gennes; for both species of men have been seen at the same time by the crew of one vessel. In 1709, the crew of the James of St. Malo saw seven of these giants in Gregory Bay, and those of the St. Peter of Marseilles saw six, whom they accosted, and offered them bread, wine, and brandy, which they refused, though they had presented the sailors with some arrows, and assisted them in bringing the ship's boat ashore. But as M. Frezier does not alledge that he himself saw any of these savages, and as the relations which mention them are full of exaggerations with regard to other subjects, the existence of a race of giants, especially so high as ten feet, must be still held as problematical: the body of such a man must be eight times the bulk of that of an ordinary person. The mean height of the human species is about five feet; and the extremes exceed not one foot above or below this standard. A man of six feet is very tall, and a man of four is very little. Giants and dwarfs who exceed these terms ought to be considered as accidental varieties, and not as distinct and permanent races.

Farther, if those Magellanic giants exist, their number must be very small; for the savages of the Straits and of the adjacent islands are of a middle stature. Their colour is olive; they have a large chest, squat bodies, thick limbs, and black straight hair. In a word, their stature exceeds not the common standard, and, both in colour and hair, they resemble the other Americans.

Thus, the whole continent of America contains but one race of men, who are all more or less tawny: and, if we except the northern regions, where we find men similar to the Laplanders, and likewise men with fair hair, like the inhabitants of the north of Europe, all the rest of this vast territory is peopled with inhabitants, among whom there is little or no diversity. In the Ancient Continent, on the other hand, we have found a prodigious variety in different nations. This great uniformity among the natives of America seems to proceed from their living all in the same manner. All the Americans were, or still are, savages: the Mexicans and Peruvians were so recently polished, that they ought not to be regarded as an exception. Whatever, therefore, was the origin of these savages, it seems to have been common to the whole. All the Americans have sprung from the same source, and have preserved, with little variation, the characters of their race; for they have all continued in a savage state, and have followed nearly the same mode of life. Their climates are not so unequal, with regard to heat and cold, as those of the Ancient Continent, and their establishment in this country has been too recent to allow those causes which produce varieties sufficient time to operate, in such a manner as to render their effects conspicuous.

Each of these reasons merits a separate discussion. That the Americans are a new people, can admit of no doubt, when we consider the smallness of their number, their ignorance, and the little progress made by the most civilized of them in the arts of life: for, though the first relations of the discovery and conquest of America mention Mexico, Peru, St. Domingo, &c. as countries full of people, and though we are told, that the Spaniards had every where to conquer numerous armies; yet it is easy to perceive that these facts are exaggerated; because, in the first place, few monuments remain of the pretended grandeur of these people; 2dly, Because their country, though now peopled with Europeans, who are unquestionably more industrious than the natives, is still wild, uncultivated, and covered with wood; and, besides, it is only a group of inaccessible and uninhabitable mountains, which, of course, leaves only small spots proper either for culture or habitation; 3dly, Because, even according to their own traditions concerning the time when they first united into society, the Peruvians reckon only 12 kings, the first of whom began to civilize them, (Hist. des Incas, par Garcilasso, &c.); and thus it appears, that not above 300 years had elapsed since the Peruvians ceased to be absolutely savage; 4thly, Because, if these people had been numerous, the Europeans, even with the advantage of gun-powder, would never have been able to enslave them. The Negroes, notwithstanding all our attempts to conquer and reduce them to subjection, still preserve their independence, though the effects of gunpowder were equally unknown and equally formidable to them as to the Americans. The facility, therefore, with which America was conquered, appears to be a demonstration that this country was thinly and recently inhabited.

In the New Continent, the temperature of the different climates is more equal than in the Ancient Continent. This effect is the production of several causes. The Torrid Zone is not so hot in America as in Africa. The territories of America comprehended under this Zone are Mexico, New Spain, Peru, the country of the Amazones, Brazil, and Guiana. The heat is never excessive in Mexico, in New Spain, or in Peru; because

these countries are greatly elevated above the ordinary surface of the globe. The thermometer, during the hottest weather, never rises so high in Peru as in France. The air is cooled by the snows which cover the tops of the mountains; and this cause, which is a consequence of the former, has great influence on the temperature of the climate. The natives also, instead of being black or very brown, are only tawny. The country of the Amazones is covered with lakes, marshes, rivers, and forests. There the air is extremely moist, and, of course, much cooler than if the land were dry. It is, besides, worthy of remark, that the east wind, which blows constantly between the Tropics, arrives not at Brasil, the Amazone country, or Guiana, till it has traversed a vast ocean, and acquired a considerable degree of cold. It is for this reason, as well as the quantity of water, forests, and almost perpetual rains, that these regions of America are much more temperate than they would otherwise be. But the east wind, in traversing the low lands of America, acquires a considerable degree of heat before it arrives at Peru. The air in Peru, therefore, would be much hotter than in Brasil or Guiana, if it were not cooled by the elevation of the country and by snows. The east wind, however, still retains so much heat as to have an influence on the colour of the natives; for those who, by their situation, are much exposed to the east wind, are more yellow than those who live in the valleys between the mountains, and are protected from its effects. Besides, this wind, after striking against the high mountains, is reflected upon the adjacent plains, and carries along with it that freshness which it acquires from the snow that covers their summits; and the melting of the snow must, of itself, frequently produce cool winds. The united operation of these causes renders the Torrid Zone of America uncommonly temperate. It is not therefore surprizing, that we find not in this country black or even brown men, similar to the natives of Africa or Asia who live under the same parallels, where the circumstances to be afterwards mentioned are extremely different. Whether we suppose, therefore, the inhabitants of America to have been anciently or recently established in that country, we ought not to find black men there; because their Torrid Zone is a temperate climate.

The last reason I mentioned to account for the little variety among the Americans, was the the uniformity in their mode of living. They were all savage or very recently civilized, and they all lived in the same manner. Supposing them to have been derived from a common origin, they were dispersed, without having their breed crossed. Each family gave rise to a nation, the inhabitants of which were not only similar to each other, but to all the neighbouring tribes. As both their food and their climates were nearly the same, they had no means either of improving or degenerating. They must, therefore, have always continued the same, whatever climate they chanced to occupy.

With regard to their origin, I have no doubt, independent of theological considerations, that it is the same with ours. The resemblance of the North American savages to the Oriental Tartars, renders it probable, that they originally sprung from the same stock. The late discoveries by the Russians of several lands and islands beyond Kamtschatka, which extend nearly as far as the west part of the Continent of America, leave no room to question the possibility of a communication, provided these discoveries were well attested, and the lands lay contiguous. But even supposing considerable intervals of sea, is it not extremely probable that some people had crossed these intervals in quest of new countries, or that they were thrown upon the American coasts by tempests? there is, perhaps, a greater interval of sea between the Marianne islands and Japan, than between any of the lands from Kamtschatka to America; and yet the Marianne islands were peopled with inhabitants who must have come from the eastern continent. I am, therefore, inclined to believe that the first men who arrived at America, landed on the north-west of California; that the extreme cold of this climate obliged them to migrate to the more southern parts of their new habitation; that they first settled at Mexico and Peru, from whence they again spread over the southern and northern regions of that continent; for Mexico and Peru must be considered as the oldest and first inhabited territories of America, because they are the most elevated, and the only countries where men were found who had formed regular societies. We may also presume, that the inhabitants of Davis's Straits and of the northern parts of Labrador, came originally from Greenland, which is separated from America only by this narrow strait; for, as I formerly remarked, the natives of Davis's Straits, and those of Greenland, have a perfect resemblance to each other. As to the manner in which Greenland was peopled, it is probable that the Laplanders would migrate from Cape-North, which is only 150 leagues from Greenland. Farther, as the island of Iceland is almost contiguous to Greenland, and is not very remote from the most northerly of the Orcades, it is probable that it has long been inhabited and frequented by the people of Europe; and that colonies had even been established in Greenland by the Danes. That white men, with fair hair, should have been found in Greenland, is not, therefore, surprising, as they derived their origin immediately from the Danes; and there is reason to think, that the white men along Davis's Straits proceeded from the European whites who had been settled in Greenland, from which they might easily pass by traversing the narrow sea that forms this strait.

America is not less singular for the uniformity in the figure and colour of its inhabitants, than Africa is

remarkable for the variety of men it contains. This part of the world is very ancient, and very populous. The climate is extremely hot; and yet the temperature of the air differs widely in different nations. Their manners also are not less various, as appears from the description I have given of them. All these causes have concurred in producing a greater variety of men in this quarter of the globe than in any other: for in examining the differences of temperature in the countries of Africa, we find, that in Barbary and all the regions adjacent to the Mediterranean, the men are white, and only a little tawny: this whole tract of country is refreshed, on one hand, by the air of the Mediterranean Sea, and by the snows on Mount Atlas, on the other: it is, besides, situated in the Temperate Zone, on this side of the Tropic. All the natives, likewise, from Egypt to the Canary islands, are only more or less tawny. Beyond the Tropic, and on the other side of Mount Atlas, the heat becomes much greater, and the inhabitants are very brown, but not entirely black. When we come, however, to the 17th or 18th degree of north latitude, under which Senegal and Nubia are situated, the heat is excessive, and the natives are perfectly black. At Senegal the liquor in the thermometer rises to 38 degrees, while it seldom rises to 30 in France, and never exceeds 25 in Peru, though it be situated under the Torrid Zone. In Nubia we have no observations made with the thermometer: but all travellers agree in declaring the heat to be excessive. The sandy deserts between Upper Egypt and Nubia heat the air to such a degree that the north wind must be extremely scorching in that country. Besides, as the east wind, which generally blows between the Tropics, arrives not at Nubia till it has traversed Arabia, it is not surprising to find the natives very black: it is still less surprising to see the inhabitants of Senegal perfectly black; for the east wind, before it reaches them, must blow over the whole of Africa in its greatest breadth, which renders the heat of the air almost insupportable. Taking, therefore, the whole of Africa situated between the Tropics, where the east wind blows most constantly, we may easily conceive why the western coasts of this part of the globe should and actually do suffer a greater degree of heat than the eastern coasts; for this wind arrives at the eastern coasts with a freshness which it acquires by traversing a vast sea; but, on the other hand, before it arrives at the western coasts it acquires a scorching heat by blowing across the interior regions of Africa. It is for this reason that the coasts of Senegal, Sierra-Leona, Guinea, and all the western parts of Africa situated under the Tropics, are the hottest climates on the globe. It is not near so hot on the eastern coasts as at Mosambique, Mombaza, &c. I cannot, therefore, hesitate in ascribing to this reason the cause of our finding the true Negroes, or the blackest men, on the western territories of Africa, and Caffres, or men of a less deep blackness, on the eastern coasts. The difference between these two kinds of blacks, which is very apparent, proceeds from the heat of the climate, which is not very hot in the eastern parts, but excessive on the western. Beyond the Tropic on the south, the heat considerably diminishes, both on account of the higher latitude, and because the point of Africa begins to turn narrow; and this point of land, being surrounded by the sea, receives fresher breezes than if it had been in the midst of a continent. The natives also of this country begin to whiten, and are naturally more white than black, as was formerly remarked. Nothing can prove more clearly that the climate is the principal cause of the varieties of mankind, than this colour of the Hottentots, whose blackness could not be diminished but by the temperature of the climate.

We will be the more confirmed in this opinion, if we examine the other people who live under the Tropics to the east of Africa. The inhabitants of the Maldiva islands, of Ceylon, of the point of the Indian Peninsula, of Sumatra, of Malacca, of Borneo, of Celebes, of the Philippine islands, &c. are all very brown, without being absolutely black; because all these territories are either islands or peninsulas. The sea in these climates has a great effect in tempering the air; and besides, the east and west winds, which blow alternately in this part of the globe, pass over a vast extent of sea, before they arrive at this Archipelago. Thus all these islands are peopled with brown men, because the heat is not excessive. But in New Guinea we find blacks, who, from the descriptions of voyagers, appear to be real Negroes; because, in this country, which extends so far to the east as to form a kind of continent, the wind which traverses it is much hotter than that which prevails in the Indian Ocean. In New Holland, which is not so hot a climate, the natives are less black, and very similar to the Hottentots. Do not these Negroes and Hottentots, who live so remote from the other people distinguished by that appellation, prove that their colour depends on the heat of the climate? no communication can ever be supposed to have taken place between Africa and this southern continent; and yet we find there the same species of men, because the same circumstances concur in producing the same degree of heat. An example taken from the other animals will still farther confirm what has been advanced. It has been remarked, that, in the province of Dauphiny, all the swine are black, but that in Vivarais, on the other side of the Rhone, where it is colder than in Dauphiny, all these animals are white. It is not probable that the inhabitants of one of these two provinces would agree to raise only black swine, and the other only white swine. It appears to me, that this phænomenon is owing to the different temperature of the climates, combined, perhaps, with the manner of feeding these animals.

The few blacks who are found in the Philippines, and some other islands of the Indian ocean, are probably derived from the Papous or Negroes of New Guinea, with which the Europeans have been acquainted for these last 50 years only. Dampier, in the year 1700, discovered the most eastern parts of this country, to which he gave the name of New Britain; but its extent is still unknown; we only know that those parts of it which have been discovered seem to be thinly inhabited.

Thus it appears that the existence of Negroes is confined to those parts of the earth where all the necessary circumstances concur in producing a constant and an excessive heat. This heat is so necessary, not only to the production, but even to the preservation of Negroes, that it has been remarked in our islands, where the heat, though great, is not comparable to that of Senegal, that the Negro infants are so liable to be affected by impressions from the air, that the proprietors are obliged to keep them, for the first nine days after birth, in close warm chambers. If these precautions be neglected, and the children exposed to the air immediately after birth, they are liable to be affected with a tetanus or locked jaw, which proves fatal, because it deprives them of the power of taking nourishment. M. Littre, who dissected a Negro in the year 1702, remarked, that the end of the glans, which was not covered with the prepuce, was black, and that the part of it which was covered was perfectly white. This observation demonstrates, that the air is necessary to produce the blackness of Negroes. Their children are born white, or rather red, like those of other men. But two or three days after birth their colour changes to a yellowish tawny, which grows gradually darker till the 7th or 8th day, when they are totally black. It is well known, that all children, two or three days after birth, are affected with a kind of jaundice, which among white people soon passes off and leaves no impression: but in negroes, on the contrary, it gives an indelible colour to the skin, which becomes always more and more black. M. Kolbe remarks, that he has seen Hottentot children, who were born as white as the Europeans, become olive in consequence of this jaundice which spreads over the skin three or four days after birth, and never goes off. This jaundice, and the impression of the air, however, are only the occasional, and not the primary causes of blackness; for it has been observed, that the children of Negroes, as soon as they come into the world, have black genitals, and a black spot at the root of their nails. The action of the air and the jaundice may perhaps help to expand this colour; but it is certain, that the rudiments of blackness are communicated to them by their parents; that, in whatever part of the world a negro is brought forth, he will be equally black as if he had been born in his own country; and that if there is any difference in the first generation, it is so small as not to be perceptible. This fact, however, implies not that the colour will continue the same after many successive generations. On the contrary, there are many reasons for presuming, that as this colour is originally the effect of a long continued heat, it will be gradually effaced by the temperature of a cold climate; and, consequently, that if a colony of Negroes were transplanted into a northern province, their descendants of the 8th, 10th, or 12th generation would be much fairer, and perhaps as white as the natives of that climate.

Anatomists have inquired into the seat of this black colour. Some of them alledge, that it neither resides in the skin nor scarf-skin, but in the cellular membrane between them; that this membrane, after long maceration in hot water, retains its original blackness; but that the skin and scarf-skin appear to be as white as those of other men. Dr. Town and some others have maintained, that the blood of the Negroes is black, and that their blackness originates entirely from their blood. I am much inclined to believe this fact; for I have observed, that among us the blood of those persons who have tawny, yellowish, or brown complexions, is blacker than that of those who are fairer. M. Barrere, who seems to have examined this subject most minutely, tells us, and Mr. Winslow agrees with him, that the scarf-skin of Negroes is black; and though its extreme tkinness and transparency may make it appear white, that it is really as black as the blackest horn, when reduced to the same degree of thinness. They also assure us, that the skin of Negroes is of a reddish brown colour, approaching to black. This colour of the Negroes, according to Barrere, is produced by their bile, which he affirms, from several dissections he made in Cayenne, instead of yellow, to be as black as ink. The bile, when absorbed and dispersed through the body, tinges the skin of white people yellow; and if it were black, it would probably produce a black colour. But as soon as the effusion of the bile ceases, the skin resumes it natural whiteness. We must therefore suppose, that the bile of the Negroes is perpetually effused, or as Barrere alledges, that it is so abundant as to be naturally secreted in the scarf-skin, and to tinge it of a black colour. Upon the whole it is probable, that both the bile and blood of Negroes are browner than those of white people, as their skin is likewise blacker. But one of these facts cannot be admitted to prove the cause of the other; for if the blackness of the blood or bile be allowed to give the same colour to the skin, then instead of demanding why the skin of Negroes is black, we ought to ask why their blood or their bile are of that colour? This species of false reasoning, in place of solving the question, renders it still more intricate. To me it has always appeared, that the same cause which makes our complexions brown, after being exposed to the action of the air, and to the rays of the sun, which renders the Spaniards more brown than

the French, and the moors than the Spaniards, also renders the Negroes blacker than the Moors. Besides, I am not here enquiring how this cause acts; I only mean to ascertain that it does act, and that its effects are more perceptible in proportion to its strength and time of acting.

The heat of the climate is the chief cause of blackness among the human species. When this heat is excessive, as in Senegal and Guinea, the men are perfectly black; when it is a little less violent, the blackness is not so deep; when it becomes somewhat temperate, as in Barbary, Mogul, Arabia, &c. the men are only brown; and, lastly, when it is altogether temperate, as in Europe and Asia, the men are white. Some varieties indeed are produced by the mode of living. All the Tartars, for example, are tawny, while the Europeans who live under the same latitude are white. This difference may safely be ascribed to the Tartars being always exposed to the air; to their having no cities or fixed habitations; to their sleeping constantly on the ground; and to their rough and savage manner of living. These circumstances are sufficient to render the Tartars more swarthy than the Europeans who want nothing to make life easy and comfortable. Why are the Chinese fairer than the Tartars, though they resemble them in every feature? because they are more polished; because they live in towns, and practise every art to guard themselves against the injuries of the weather; while the Tartars are perpetually exposed to the action of the sun and air.

But when the cold becomes extreme, it produces effects similar to those of violent heat. The Samoiedes, the Laplanders, and the natives of Greenland, are very tawny. We are even assured, that some of the Greenlanders are as black as the Africans. Here the two extremes approach each other: great cold and great heat produce the same effect upon the skin, because each of these causes acts by a quality common to both; and this quality is the dryness of the air, which perhaps is equally great in extreme cold as in extreme heat. Both cold and heat dry the skin, and give it that tawny hue which we find among the Laplanders. Cold contracts all the productions of nature. The Laplanders, accordingly, who are perpetually exposed to the rigours of frost, are the smallest of the human species. Nothing can afford a stronger example of the influence of climate than this race of Laplanders, who are situated, along the whole polar circle, in an extensive zone, the breadth of which is limited by nothing but excessive cold; for that race totally disappears whenever the climate becomes a little temperate.

The most temperate climate lies between the 40th and 50th degree of latitude, and it produces the most handsome and beautiful men. It is from this climate that the ideas of the genuine colour of mankind, and of the various degrees of beauty, ought to be derived. The two extremes are equally remote from truth and from beauty. The civilized countries situated under this zone, are Georgia, Circassia, the Ukraine, Turkey in Europe, Hungary, the south of Germany, Italy, Switzerland, France, and the northern part of Spain. The natives of these territories are the most handsome and most beautiful people in the world.

The climate may be regarded as the chief cause of the different colours of men. But food, though it has less influence upon colour, greatly affects the form of our bodies. Coarse, unwholesome, and ill prepared food, makes the human species degenerate. All those people who live miserably are ugly and ill-made. Even in France the country people are not so beautiful as those who live in towns; and I have often remarked, that in those villages where the people are richer and better fed than in others, the men are likewise more handsome and have better countenances. The air and the soil have great influence upon the figure of men, beasts, and plants. In the same province, the inhabitants of the elevated and hilly parts are more active, nimble, handsome, ingenious, and beautiful, than those who live in the plains, where the air is thick and less pure. In France, it is impossible to perpetuate the race of Spanish or Barbary horses: they degenerate even in the first generation, and in the third or fourth, unless the breed be crossed by the importation of fresh stallions, they become altogether French horses. The effects of climate and of food upon animals are so well known, that we need hardly mention them: and though their operation is slower and less apparent upon men; yet from analogy, we ought to conclude, that their effects are not less certain, and that they manifest themselves in all the varieties we find among the human species.

Upon the whole, every circumstance concurs in proving, that mankind are not composed of species essentially different from each other; that, on the contrary, there was originally but one species, who, after multiplying and spreading over the whole surface of the earth, have undergone various changes by the influence of climate, food, mode of living, epidemic diseases, and the mixture of dissimilar individuals; that, at first, these changes were not so conspicuous, and produced only individual varieties; that these varieties became afterwards specific, because they were rendered more general, more strongly marked, and more permanent by the continual action of the same causes; that they are transmitted from generation to generation, as deformities or diseases pass from parents to children; and that, lastly, as they were originally produced by a train of external and accidental causes, and have only been perpetuated by time and the constant operation of these causes, it is probable that they will gradually disappear, or at least that they will differ from what they are at present, if the causes which produced them should cease, or if their operation should be varied by other circumstances and combinations.

A

DISSERTATION ON THE NATURE OF ANIMALS.

ALL our knowledge is derived from comparing the relations and differences which subsist between objects. If brute animals had no existence, the nature of man would be still more incomprehensible. Having formerly considered man as a detached being, let us now institute a comparison between him and the other animals. Let us examine the nature of the animal world: let us investigate their organization, and study their general œconomy. This inquiry will enable us to draw particular inferences, to discover, relations, to reconcile apparent differences, and, from a combination of facts, to distinguish the principal effects of the living machine, and lead us to that important science, of which man is the ultimate object.

I shall begin with explaining the subject, and by reducing it to its just limits.

The general properties of matter, being common to animated as well as inanimated beings, belong not to our subject. The qualities possessed in common by plants and animals, ought likewise to be rejected. It is for this reason that we have treated of nutrition, of growth, of reproduction, and even of generation, properties common to the plant and animal, before entering upon those qualities which are peculiar to animated bodies.

In the next place, as many beings are comprehended in the class of animals, whose organization differs greatly from that of man and the more perfect animals, we shall likewise keep these out of our view, and examine such only as make the nearest approaches to ourselves.

But as man is not a simple animal, and as his nature is superior to that of other animals, we shall endeavour to investigate the cause of this superiority, that we may be enabled to distinguish what is peculiar to him, from what he possesses in common with other animated beings.

Having thus circumscribed our subject, and lopt off its extremities, we shall proceed to the general division of it. Before giving a detail of the various parts, and of their functions, let us attend to the general results of the animal machine; and before reasoning upon the causes, let us enumerate and describe the effects.

An animal is distinguished by two modes of existence, that of motion, and that of rest, which alternately succeed one another during the whole of life. In the former, all the springs of the machine are in action; in the latter, all is at rest, except one part, and that part acts equally when the animal is asleep and when it is awake. This part, therefore, is absolutely necessary, since the animal without it cannot exist. This part is likewise independent of the other, because it can act alone; and the other part depends upon this, because it cannot act without its assistance. The one is a fundamental part of the animal œconomy, because it acts continually and without interruption; the other is less essential, because it acts only by alternate intervals.

This first division of the animal œconomy is general, and seems to be well founded. It is not so difficult to examine an animal when asleep, as when awake and in action. This distinction is essential, and not a simple change of condition, as in an inanimated body, which is equally indifferent to rest or motion; for an inanimated body would continue perpetually in either of these states, unless it were constrained to change, by the application of some impelling or resisting force. But an animal changes its state by its own proper powers. It passes naturally and without restraint from motion to rest, and from rest to motion. The moment of awaking returns as necessarily as that of sleep, and both happen independent of foreign causes; because the animal can exist during a certain time only in either state; and continued waking or sleeping would be equally fatal to life.

The animal œconomy then may be divided into two parts; the first of which acts perpetually without any interruption, and the second acts by intervals only. The action of the heart and lungs, in animals which respire, and the action of the heart in the fœtus state, constitute the former; and the action of the senses, joined to the movements of the members, constitute the latter.

If we conceive the existence of beings endowed by Nature with this first part of the animal œconomy only, though deprived of sense and progressive motion, they would still be animated, and would differ in nothing from animals asleep. An oyster, or a zoophyte, which appear not to possess either external senses, or the power of progressive motion, are animals destined to sleep continually. A vegetable, in this view, is a sleeping animal: and, in general, every organized being,

deprived of sense and motion, may be compared to an animal constrained by Nature to perpetual sleep.

Sleep in the animal, therefore, is not an accidental state induced by the exercise of its functions while awake: it is, on the contrary, an essential mode of existence, and serves as a basis to the animal œconomy. Our being commences with sleep; the fœtus sleeps perpetually; and the infant consumes most of its time in that state.

Sleep, therefore, which appears to be a state purely passive, a species of death, is, on the contrary, the original condition of animated beings, and the very foundation of life itself. It is not a privation of certain qualities and exertions, but a real and more general mode of existence than any other. With sleep our existence commences: all organized beings, which are not endowed with senses, remain perpetually in this condition; none exist in continued action; and the existence of every animal consists more or less of this state of repose.

If the most perfect animal were reduced to that part alone which acts perpetually, it would not differ, in appearance, from those beings to which we can hardly ascribe the name of Animal. With regard to external functions, it would have a striking resemblance to a vegetable; for, though the animal and vegetable differ in external organization, they both exhibit the same results: they both receive nourishment, grow, expand, and are endowed with internal movements and a vegetating life. On this supposition, they would be equally deprived of progressive motion, action, and sentiment; and they would have no external or apparent character of animation. But if this internal part be clothed with a proper cover, or, in other words, if it be endowed with senses and members, animal life will instantly manifest itself; and in proportion to the quantity of sense and members contained in this cover, the animation will be more complete, and the animal more perfect. It is this envelope or cover therefore, which constitutes the distinction between different animals. The internal part, which is the basis of the animal œconomy, is common to every animated being without exception; and as to its mode, it is nearly the same in man and in all animals which consist of flesh and blood. But the external cover is exceedingly diversified, and the greatest differences originate from the extremities of this cover.

To illustrate this subject, let us compare the body of a man with that of a horse, an ox, &c. The internal part, which acts perpetually, namely the heart and lungs, or the organs of circulation and respiration, is nearly the same in man and in the animal. But the external cover is extremely different. The solids of the animal's body, though composed of parts similar to those of the human frame, differ prodigiously in number, magnitude, and position. The bones are more or less shortened, rounded, lengthened, flattened, &c. Their extremities are more or less elevated, or hollowed; and several of them are sometimes united into one. Some, as the clavicles, are entirely wanting; the number of others is augmented, as the cartilages of the nose, the vertebræ, the ribs, &c. Of others the number is diminished, as the bones of the carpus, metacarpus, tarsus, metatarsus, phalanges, &c. which give rise to great varieties in the figure of animals, compared with that of the human body.

We will be still farther convinced, that the principal distinctions between the body of man, and those of the other animals, arise from the extremities, if we attend to the following circumstances. Let us divide the body into three principal parts, the trunk, the head, and the members. The head and members, which are the extremities of the body, constitute the chief differences between man and the other animals. By examining these three principal parts, we find that the greatest differences in the trunk are found at its superior and inferior extremities; for the animals have no clavicles on the superior extremity of the trunk, and the inferior is terminated by a tail, which consists of a certain number of external vertebræ, that exist not in man. In the same manner, the inferior extremity of the head, or jaw-bones, and the superior or frontal bone, differ widely in man and the quadrupeds: the jaw-bones of most animals are greatly lengthened, and their frontal bones, on the contrary, are contracted. In fine, by comparing the members of a brute with those of a man, it is easy to perceive that they differ chiefly in their extremities; for, at the first glance of the eye, nothing has less resemblance to the human hand than the foot of a horse or an ox.

Regarding the heart, therefore, as the centre of the animal machine, it is obvious that man resembles the other animals in this and the neighbouring parts; and that the farther from this centre, the differences become more considerable, till we arrive at the extremities, where they are by much the greatest. But where this centre, or the heart itself differs, then the animal is infinitely removed from man, and possesses nothing in common with the creatures under consideration. In most insects, for example, the organization of this principal part of the animal œconomy is singular. Instead of a heart and lungs, we find parts which perform similar functions, and for that reason have been regarded as analogous to those viscera, but which in reality are very different, both in their structure and in the result of their action. Insects, accordingly, differ as much as possible from man and the quadrupeds. A slight variation in the central parts is always accompanied with an amazing difference in the external configuration. The heart of a turtle is of a singular structure; and its figure is so extraordinary, that it has no resemblance to any other creature.

In contemplating men, quadrupeds, birds, fishes, and

reptiles, what a prodigious variety occurs in the figure and proportion of their bodies, in the number and position of their members, in the substance of their flesh, bones, and integuments? The quadrupeds have tails and horns; and all their extremities differ remarkably from those of man. The cetaceous animals live in a different element; and though they generate in a manner similar to the quadrupeds, their figure is extremely different, being totally deprived of inferior extremities. The birds differ still more from man, by their beak, their feathers, their flying, and their multiplication by means of eggs. The fishes and amphibious animals are still farther removed from the human figure; and the reptiles are entirely destitute of members. Thus we find that the greatest diversity consists in the envelope or external cover, the internal structure on the contrary being nearly the same: all animals are furnished with a heart, a liver, a stomach, intestines, and organs of generation. These therefore ought to be regarded as the most essential parts of the animal œconomy, because they are the most constant, and least subject to variation.

But it is worthy of remark, that even in this cover some parts are more constant than others. None of these animals are deprived of all the senses. In treating of the senses we explained what might be their species of feeling. We know not the nature of their smelling and taste; but we are certain that they are all endowed with the sense of seeing, and perhaps also with that of hearing. The senses therefore may be considered as another essential part of the animal œconomy, as well as the brain, which is the origin of all sensation. Even the insects, which differ so much in their central parts from other animals, have something analogous to a brain, and its functions are similar to those of the other animals: and those animals, as the oyster, which seem to be deprived of a brain, ought to be regarded as beings only half animated, and as forming the shade between animal and vegetable life.

Thus we have discovered the brain and the senses to be a second essential part of the animal œconomy. The brain is the centre of the envelope or cover, as the heart is the centre of the internal part of the animal. It is from the brain that the external parts receive their power of moving and acting, by means of the spinal marrow and the nerves, which are only prolongations of this marrow: and as the heart and the whole interior parts communicate with the brain and external cover, by means of the distribution of blood-vessels, the brain has a similar communication with the internal parts by the ramifications of the nerves. This union is intimate and reciprocal; and though the functions of the two organs be totally different, they cannot be separated without instant destruction to the animal.

The heart and the whole internal parts act continually, without the smallest interruption, and independent of external causes. But the senses and envelope act only by alternate intervals, and successive vibrations excited by external causes. Objects act upon the senses, and this action is modified by the senses, and transported in this modified form to the brain, where the impression first receives the appellation of sensation: the brain, in consequence of this impression, acts upon the nerves, and communicates the vibrations it receives; and these vibrations produce progressive motion and all the other external actions of the body. When a body is acted upon by any cause, it is well known, that the body re-acts upon the cause. Thus objects act upon animals by means of the senses; and animals re-act upon objects by their external movements; and in general action is the cause, and re-action the effect.

The effect, it may be said, is not in this case proportioned to the cause; in solid bodies which follow the laws of mechanism, action and re-action are always equal. But in the animal body, re-action or external motion seems to be incomparably greater than action; and consequently progressive motion, and the other external movements, ought not to be regarded as simple effects of the impressions of objects upon the senses. To this objection I reply, that though effects in certain circumstances appear to be proportioned to their causes; yet there are in nature innumerable instances where the effects have no proportion to their apparent causes. A single spark of fire will inflame a magazine of powder, and blow up a citadel. A slight friction produces by electricity a concussion so violent, that it is communicated to great distances, and affects equally a thousand persons at the same time. It is not therefore surprising that a slight impression on the senses should produce a violent re-action in the animal body, manifesting itself by external movements.

Causes which admit of measurement, and the quantity of whose effects can be exactly estimated, are not so numerous as those whose qualities and manner of acting are perfectly unknown; and, consequently, the proportion they may have to their effects must be equally unknown. To measure a cause it must be simple; its action must be constant and uniformly the same, or at least it must vary according to a known law only. Now, most effects in nature are produced by a combination of different causes, the action of which varies, and which observe no constant law; and of course they can neither be measured nor estimated but by endeavouring to approach the truth by probable conjectures.

I pretend not therefore to lay it down as a demonstrated fact, that progressive motion, and the other external movements of animals, have no other cause but that of the impressions of objects upon the senses. I only say, that the fact is probable, and seems to be founded on strong analogies; for I find, that all organized beings which are deprived of senses, are likewise

deprived of the power of progressive motion, and that all those which are endowed with senses, enjoy likewise the loco-motive faculty. I also find that this action of objects upon the senses often makes the animal move instantaneously, and even involuntarily; and that, when the movement is determined by the will, it is always the effect either of the immediate action of objects upon the senses, or of the remembrance of a former impression.

To render this matter more clear, let us analyse the physical laws of our own actions. When an object strikes any of our senses, and produces an agreeable sensation, and of course a desire, this desire must have a relation to some quality or mode of our enjoyment. We cannot desire an object in any other way than to have an inclination to see, hear, taste, smell, or touch it; and this desire is only to gratify more fully either that sense with which we perceive the object, or some of our other senses at the same time; or in other words, to heighten the agreeableness of the first sensation, or to excite another, which is a new mode of enjoying an object: for the moment we perceive our object, if we could fully enjoy it by all the senses at once, we would have nothing to desire. Desire then originates from our being ill situated with regard to the object perceived. We are either too near it, or too distant. We therefore naturally change our situation; because at the same time that we perceive the object, we also perceive the obstruction to the full enjoyment of it, arising from the distance or proximity of our situation. Hence the movements we perform in consequence of desire, and the desire itself, proceed entirely from the impression made by the object upon our senses.

When we perceive an object with the eye, and have an inclination to touch it, if it be near, we seize it with our hand, and if at a distance, we move forward in order to approach it. A man, when deeply occupied with study, if he be hungry, will lay hold of bread which he feels under his hand, and even carry it to his mouth and eat it, without being conscious of his having acted in this manner. These motions necessarily result from the first impression made by the object; and they would never fail to succeed the impression, if this natural effect were not opposed by other impressions, which, by acting at the same time, often weaken and efface the action of the first.

An organized being therefore, without sensation, as an oyster, which probably enjoys the sense of feeling very imperfectly, is deprived not only of progressive motion, but of sentiment and intelligence; because each of them would equally excite desire, and this desire would manifest itself by external movements. I am uncertain whether beings deprived of senses have any perception of their own existence; if they have, it must be very imperfect, since they are unable to perceive the existence of others.

To illustrate this subject still farther, let us suppose a man, at the moment he wishes to approach an object, suddenly deprived of all his members, would he not endeavour to trail his trunk along the ground in order to gratify his desire? Nay, were he reduced to a globular form, and actuated by the same desires, though deprived of every faculty of motion, he would still exert all his force to obtain a change of situation: but on this supposition, as he could only act against the point that supported him, he would still evince his passion by raising his body. Thus external and progressive motion depend not on the organization and figure of the body, since whatever be the conformation of any being, if endowed with senses and a desire of gratifying them, it would not fail to move.

The facility, the quickness, the direction, and the continuation of motion, depend, it is true, upon external organization: but the cause, principle, and determination of it proceed solely from desire, excited by the impression of objects upon the senses; for if a man were deprived of sight, he would make no movement to gratify his eyes. The same thing would happen if he were deprived of any of the other senses; and if deprived of every sense, he would remain perpetually at rest; and no object would excite him to move, though by his external conformation he were fully capable of motion.

Natural wants, as that of taking nourishment, are internal movements, which necessarily excite desire or appetite. These movements may produce external motion in animals; and provided they are not entirely deprived of external senses relative to these wants, they will act in order to supply them. Want is not desire; the former differs from the latter as cause differs from effect; desire therefore cannot be produced without the intervention of senses. Whenever an animal perceives an object fitted to supply its wants, desire is instantly excited, and action or motion succeeds.

The action of external objects must necessarily produce some effect; and it is easy to perceive that this effect is animal motion; since every time the senses are struck in the same manner, the same movements uniformly succeed. But how does the action of objects excite desire or aversion? How shall we obtain a clear conception of the operation of that principle to which the senses communicate their notices? The senses are only the middle term between the action of objects and animal action. This principle however has the power of determining all our motions; for it can modify and alter the animal action, and even sometimes counteract it, notwithstanding the impression of objects.

With regard to man, whose nature is so different from that of other animals, this question is difficult to solve; because the soul participates all our movements; and it is not easy to distinguish the effects of this spiritual

substance from those produced solely by the material part of our frame. Of this we can form no judgment but by analogy, and by comparing our actions to the natural operations of the other animals. But as this spiritual substance has been conferred on man alone, by which he is enabled to think and reflect, and as the brutes are purely material, and neither think nor reflect, and yet act, and seem to be determined by motives, we cannot hesitate in pronouncing the principle of motion in them to be perfectly mechanical, and to depend absolutely on their organization.

I apprehend, therefore, that in the animal, the action of objects on the senses produces another on the brain, which I consider as a general internal sense, that receives all the impressions transmitted to it by the external senses. This internal sense is not only susceptible of vibrations from the action of the senses, but is capable of retaining for a long time the vibrations thus excited; and it is the continuation of these vibrations that constitute impressions, which are more or less deep, in proportion to the duration of the vibrations.

The internal sense, therefore, differs in the first place, from the external senses by the faculty which it possesses of receiving every species of impression; while the external senses are only affected in one mode, corresponding to their conformation: the eye, for instance, is not more affected with sound than the ear with light. 2dly, The internal sense differs from the external senses, by the duration of the vibrations excited by external causes. In every other article, both these species of senses are of the same nature. The internal sense of a brute, as well as its external senses, are pure results of matter and mechanical organization. Like the animal, man possesses this internal material sense; but he is likewise endowed with a sense of a very different and superior nature, residing in that spiritual substance which animates us, and superintends our determinations.

Hence the brain of an animal is a general sense, which receives all impressions transmitted to it by the external senses; and these impressions or vibrations continue longer in the internal than the external senses. Of this fact we may easily form a conception, since the duration of impressions, even on the external senses, is very different. The impression of light on the eye is well known to last much longer than that of sound on the ear. A rapid succession of sounds can be heard distinctly; but a succession of colours equally rapid confounds the eye. It is for this reason that the vibrations transmitted to the internal sense by the eye are stronger than those conveyed by the ear, and that we describe objects which we have seen in a more lively manner than those we have heard. The vibrations excited by objects on the eye seem to continue longer than those made upon any of the other senses; and therefore it appears to participate more of the nature of the internal sense. This might be proved by the quantity of nerves expanded on the eye; for it alone receives nearly as many as the three organs of hearing, smelling, and tasting.

The eye, therefore, may be regarded as a continuation of the internal sense. It consists, as was remarked in another place, almost entirely of nervous fibres, and is only a prolongation of the organ in which the internal sense resides. It is not, of course, surprising that this sense should make the nearest approach to the internal sense. Its impressions are not only more durable, but, like the internal sense, it possesses powers of a nature superior to those of the other senses.

The eye exhibits external marks of internal impressions. It expresses desire or aversion excited by agreeable or disagreeable objects. Like the internal sense, it is active; but all the other senses are purely passive: they are simple organs, destined for the reception of external impressions, but incapable of preserving or reflecting them.

When any of the senses, it must be allowed, are long and strongly acted upon, the vibrations continue some time after the action of the object has ceased. But the eye possesses this power in a super-eminent degree; and it is only exceeded by the brain, which not only preserves the impressions received, but propagates their action by communicating vibrations to the nerves. The external organs of sense, the brain, the spinal marrow, and the nerves, which are expanded over the whole body, ought to be regarded as one continued mass, as an organic machine, of which the senses are the parts to which the action of external objects is applied. The brain is the fulcrum or basis; and the nerves are the parts which receive motion from the acting powers. But what renders this machine different from all others is, that its fulcrum not only resists and re-acts, but is even active itself; because it long retains received impressions. And as this internal sense, the brain and its membranes, is very large, and endowed with great sensibility, it can admit many successive and contemporary vibrations, and retain them in the same order they were received; because each impression communicates vibrations to one part only of the brain, and successive impressions affect the same part, or contiguous parts, in a different manner.

If we suppose an animal deprived of a brain, but endowed with an external sense of great extent and sensibility, as an eye, for example, having a retina as large as the brain, and possessing the faculty of retaining received impressions; it is certain, that an animal of this kind would see, at the same time, both present objects, and those which it had formerly seen; because, on this supposition, the vibrations always remaining, and the extent of the retina being large enough to receive them on different parts, the animal would perceive, at the same

time, both present and past objects; and would, therefore, be mechanically determined to act according to the number or force of the vibrations produced by the images corresponding with, or opposite to this determination. If the number of images fitted to excite desire supassed those suited to produce aversion, the animal would necessarily be determined to move, in order to gratify this appetite: but if the number and force of different images were equal, the animal having no superior motive, would remain at rest. I say, that all this would happen mechanically, and without the intervention of memory; for, by seeing and being acted upon by all the images at the same time, those which correspond with desire would be opposed by those that correspond with aversion, and from this equilibrium, or from the excess in number or force of one set of images above another, the animal could alone be determined to rest or to action.

From these facts it appears, that in brutes the internal sense differs only from the external senses, by the faculty it possesses of retaining received impressions. This faculty is alone sufficient to explain all the actions of animals, and to give us some idea of what passes within them. It likewise demonstrates the essential and infinite difference between them and us, and at the same time enables us to distinguish what we possess in common with them.

Animals have some senses of exquisite acuteness; but in general they are not all equal to those of man: and it is worthy of remark, that the degrees of excellence in the senses follow not the same order in the brute, as in the human species. The sense most analogous to thinking is that of touch; and this sense is more perfect in man than in the other animals. The sense of smelling is most analogous to instinct and appetite; and the brute enjoys it in a superior degree. Hence man should excel in knowledge, and the brute in appetite. In man, the first sense for excellence is touching, and smelling is the last: in the brute, the sense of smelling is the first, and that of touching is the last. This difference has a perfect correspondence to the nature of each. The sense of seeing is exceeding imperfect and delusive, without the aid of that of touching; and the former, accordingly, is less perfect in the brute than in man. The ear, though perhaps equally well constructed in the animals as in man, is not nearly so useful to them, because they are deprived of speech, which in man depends on the ear, an organ which gives activity to this sense, and enables him to communicate his ideas: but hearing in the brute, is a sense almost entirely passive. Hence man enjoys the senses of touching, seeing, and hearing, more perfectly, and that of smelling more imperfectly, than the animal; and as taste is an internal smelling, and is more analogous to appetite than any of the other senses, the animals also possess it in a superior degree, as appears from their invincible aversion against certain aliments, and their natural appetite for such as correspond to their constitutions: but man, if he were not instructed, would eat the fruit of the mancinella like an apple, and the hemlock like parsley.

The excellence of the senses is the gift of Nature; but art and habit may bestow on them a greater degree of perfection. A musician whose ear is accustomed to harmony, is shocked with discord: a painter with one glance of his eye, perceives a number of shades which escape a common observer. The senses, and even the appetites of animals, may also be improved. Some birds learn to sing, and to repeat words; and the ardour of a dog for the chase may be increased by rewarding him for his labours.

But this excellence and improvement of the senses are most conspicuous in the brute, who always appears to be more active and intelligent in proportion to the perfection of his senses. Man, on the contrary, has too great a portion of reason and genius to bestow much attention to the improvement of his ear or his eye. Persons who are short-sighted, dull of hearing, or insensible of smell, suffer not for that reason, any diminution of capacity: an evident proof that man is endowed with something superior to an internal animal sense, which is a material organ, similar to the external organs of sensation, and differs from them only by the faculty of retaining received impressions. But the soul of man is a superior sense, or spiritual substance totally different, both in its action and essence, from the nature of the external senses.

We mean not, however, to maintain that man is not possessed of an internal material sense, analogous to the external senses. Inspection alone is sufficient to establish this point. In man the brain is proportionally larger than in any other animal, which is an evident proof of his being endowed with this internal material sense. What I mean to inculcate is, that this sense is infinitely superior to the other. It is subject to the commands of the spiritual substance, which at pleasure suppresses, or gives rise to all its operations. In the animal this sense is the principle which determines all its movements; but in man, it is only an intermediate and secondary cause of action.

But let us examine more closely the powers of this internal material sense. When we have once fixed the extent of its action, every thing beyond this limit must of necessity originate from the spiritual sense, and we will be furnished with a criterion for distinguishing what we possess in common with the other animals, and in what articles we excel them.

The internal material sense receives indifferently every impression conveyed by the external senses. These impressions proceed from the action of objects, and quickly pass through the external senses, where they only excite momentary vibrations. But their progress

stops at the brain, and produce in this organ of the internal sense vibrations which are both distinct and durable. These vibrations give rise to desire or aversion, according to the present state and disposition of the animal. Immediately after birth the young animal begins to respire, and to feel a desire for food. The organ of smelling receives the effluvia of the milk contained in the dugs of the mother. Vibrations are excited in this sense by the odorous particles, and these vibrations are transmitted to the brain, which in its turn acts upon the nerves; and the animal is thus stimulated to make the proper movements, or in other words, to open its mouth, in order to procure the nourishment desired. The senses peculiar to appetite being more obtuse in man than in brutes, the new-born child feels only the desire of taking nourishment, which he announces by crying. But he is incapable of procuring it himself; neither is he stimulated by the sense of smelling; his mouth must be applied to the breast, before he can use the means of gratifying his appetite. Then indeed the senses of smelling and of touching communicate vibrations to the brain, which, by re-acting on the nerves, stimulates the child to make the necessary motions for receiving and sucking the milk. It is only by the senses of appetite, namely, those of smelling or tasting, that the brute animal is apprised of the presence of nourishment, or of the place where it is to be found. Its eyes are not yet open; and though they were, they would not at first be capable of determining it to use the proper efforts. The eye, which is a sense more analogous to intelligence than to appetite, is open in man from the moment of birth; but remains shut, in most other animals, for several days. The senses of appetite, on the contrary, are more perfect and mature in the young animal than in the infant. This circumstance affords another proof, that in man the organs of appetite are less perfect than those of intelligence; and that in the animal, the organs of intelligence are more imperfect than those of appetite.

The same remark may be made with regard to progressive motion, and all the other external movements. It is long before the infant can use its members, or has strength enough to change place. But a young animal soon acquires these faculties. These powers in the animal are all relative to appetite, which is vehement, quickly unfolded, and the sole principle of motion. But appetite in man is feeble, long before it is unfolded, and ought not to have such influence as intelligence upon the determination of his movements. Man therefore is in this respect later in arriving at maturity.

Hence every circumstance, even in physics, concurs in demonstrating that the brutes are actuated by appetite only, and that man is influenced by a superior principle. The only doubt that remains is the difficulty of conceiving how appetite alone should produce in animals effects so similar to those produced in men by intelligence; and how to distinguish the actions we perform in consequence of our intellectual powers from those which originate from the force of appetite. I despair not however of being able to remove this difficulty.

The internal material sense, as formerly remarked, retains for a long time the vibrations it receives. This sense, the organ of which is the brain, is common to every animal, and receives impressions transmitted to it by each of the external senses. When an object acts upon the senses, this action produces lasting vibrations in the internal sense, and these vibrations communicate motion to the animal. When the impression proceeds from the senses of appetite, the movement is determined, the animal either advances to lay hold of the object, or flies to avoid it. This motion may be uncertain when the impression is transmitted by the senses analogous to intelligence, as the eye and the ear. When an animal sees or hears for the first time, he feels the impression of light or of sound; but the motions produced must be uncertain, because these senses have no relation to appetite. It is only by repeated acts, and after the animal has joined to the impressions of seeing or hearing those of smelling, tasting, or touching, that he feels a determination to approach or retire from objects which experience alone renders analogous to his appetite.

To illustrate this subject let us examine the conduct of an animal that has been instructed by man. A dog, for example, though excited by the most violent appetite, will not venture to wrest from the hand of his master the object that would gratify him, but he at the same time makes a number of movements in order to obtain it. Does not the dog in this case seem to combine ideas? Does he not appear to desire, and to fear, in a word, to reason nearly in the same manner as a man when violently tempted to take what belongs to another, but is restrained by the fear of punishment? This is the vulgar mode of accounting for the conduct of animals. We naturally transfer our own motives to animals, when placed in similar circumstances; and the analogy is said to be well founded, because in man and in the animal the conformation of both the internal and external senses is similar. Though this analogy however were just, is not something more required? Is it not necessary that the animals should on some occasions do every thing which we perform? But the contrary is evident; animals never invent nor bring any thing to perfection; of course they have no reflection; they uniformly do the same things in the same manner. This destroys the force of analogy so much that we may even doubt of its reality: we ought therefore to inquire whether the actions of brutes proceed not from principles entirely different from those which actuate men, and whether their senses alone are not sufficient to produce their actions,

without the necessity of ascribing to them the powers of reflection.

Their internal sense is strongly agitated by every thing that relates to their appetites. A dog would instantly seize the object he desires, if his internal sense retained not impressions of pain that had formerly accompanied this action. But the animal has received new qualities from external impressions: this prey is not presented to a simple dog, but to a dog that has been beat: every time he implicitly obeyed the dictates of appetite has been followed with blows: the impressions of pain therefore uniformly accompany those of appetite, because they have always been made at the same time. The animal being thus acted upon at once by two contrary impulses, which mutually destroy each other, he remains in equilibrio between two equal powers. The cause determining him to motion being counterbalanced, he makes no effort to obtain the object of his desire. But though the vibrations occasioned by appetite and aversion, or by pleasure and pain, destroy the effects of each other, a third vibration, which always accompanies the other two, is renewed in the brain of the animal by the action of his master, from whose hand he has often received his food: and as this third vibration is not counterbalanced by any opposite power, it becomes a cause sufficient to excite motion. The dog is therefore determined to move towards his master, and to frisk about till his appetite be fully gratified.

In the same manner, and upon the same principles, may all the actions of animals, however complicated they appear, be explained, without the necessity of attributing to them either thought or reflection. Their internal sense is sufficient to produce every motion they perform. One thing only remains to be illustrated, and that is the nature of their sensations, which, according to the present doctrine, must be very different from ours. Have the animals, it may be asked, no knowledge, no sentiment, or no consciousness of their existence? Since you pretend to explain all their actions by mechanism, do you not reduce them to mere machines, or insensible automatons?

If I have properly explained myself, the reader ought to perceive, that so far from depriving animals of all powers, I have already allowed them the possession of every thing but thought and reflection. Their feelings are even more exquisite than ours. They are conscious of their actual or present existence; but they have no knowledge of that existence which is past. They have sensations; but they want the faculty of comparing them, or of forming ideas; for ideas are only the results of the association or comparison of sensations.

Let us consider each of these articles separately. The feelings of animals are more exquisite than those of man. This, I imgine, has already been sufficiently proved by what was remarked concerning the excellence of their senses relative to appetite; by their natural and invincible aversion against certain objects, and their uniform and determincd attachment to others; and by their faculty of instantly distinguishing with certainty what is salutary or noxious. Animals, therefore, as well as men, are capable of pleasure and pain. They have no knowledge of good and evil; but they feel the distinction. Whatever is agreeable to them is good, and whatever is disagreeable is bad. Both are only relations conformable or repugnant to their nature and organization. The pleasure of tickling, and the pain of a wound, are common to us and the animals; because they depend absolutely upon an external material cause, namely, a weaker or stronger action in the nerves, which are the organs of sensation. Every thing that acts gently on these organs gives pleasure; and every thing that acts with violence excites pain. All sensations then are sources of pleasure when they are temperate and natural; but when too violent they produce pain, which in physics is the extreme rather than the opposite of pleasure.

Disagreeable sensations are excited by a light too brilliant, too near an approach to fire, loud noises, strong smells, insipid or coarse victuals, and hard friction. But a gentle light, a moderate heat, a soft sound, a delicate perfume, a fine savour, and slight friction, produce sensations of the most agreeable kind. Thus every gentle application to the senses is pleasure, and every shock or violent impression is pain. As the causes therefore which give rise to violent impressions occur more seldom in nature than those that produce soft and moderate movements; and as animals by the exercise of their senses soon acquire the habit of avoiding hurtful objects, and of distinguishing and approaching such as are agreeable to them, the sum of agreeable sensations must exceed that of the disagreeable; and therefore the quantity of pleasure must be greater than that of pain.

If animal pleasure consists of whatever flatters the senses, and if in physics what flatters the senses be every thing that corresponds to nature; if, on the other hand, pain be whatever wounds the organs, and is repugnant to nature; if, in a word, pleasure be physical good and pain physical evil, it is evident that every sentient being must enjoy more pleasure than pain; for every thing that corresponds with his nature, contributes to his preservation, or supports his existence, is pleasant; and every thing that tends to his destruction, to derange his organization, or to change his natural condition, is pain. It is by pleasure alone therefore, that a sentient being can continue to exist; and if the sum of agreeable sensations surpassed not that of the disagreeable, deprived of pleasure he would first languish for want of good, and loaded with pain he would next perish by a superabundance of evil.

In man, physical good and evil constitute the smallest

part of his pleasures and pains. His imagination, which is never idle, is a constant source of unhappiness; for it presents to the mind nothing but vain phantoms, or exaggerated pictures. More occupied by these illusions than by real objects, the mind loses both its faculty of judging and its empire: it compares chimeras only; it sees only at second hand, and often sees impossibilities. The will, of which the mind has now no command, becomes a burden: in fine, his extravagant desires are real pains, and his vain hopes are at most but false pleasures, which vanish as soon as the mind resumes its faculty of discerning and of judging without passion.

Thus when we search for pleasure, we create to ourselves pain; we are miserable from the moment we desire to augment our happiness. Good exists only within ourselves, and it has been bestowed on us by Nature; evil is external, and we go in quest of it. The peaceable enjoyment of the mind is our only true good: we cannot augment this good, without the danger of losing it: the less we desire, the more we possess: whatever we wish beyond what Nature has bestowed on us is pain; and nothing is pleasure but what she offers us.

Now, pleasures innumerable are constantly presented to us by Nature: she has provided for our wants, and fortified us against pain: physical good infinitely exceeds physical evil. It is not therefore realities, but chimeras, which we ought to dread. Neither bodily pain, nor disease, nor death, are formidable; but agitation of mind, the passions, and languor, are the only evils we have to apprehend.

The animals have only one mode of acquiring pleasure, the exercise of their sensations to gratify their desires. We also possess this faculty: but we are endowed with another source of pleasure, the exercise of the mind, the appetite of which is the desire of knowledge. This source of pleasure would be more pure and copious, were its current not interrupted by our passions, which destroy all contemplation. Whenever they obtain the ascendant, reason is silenced, or only makes feeble and unavailing efforts. We of course lose all relish of truth; the charm of illusion augments; error fortifies its dominion, and drags us on to misery: for what misery can be greater than no longer to see things as they are, to have the faculty of judging perverted by passion, to act only according to its dictates, to appear, consequently, unjust or ridiculous to others, and lastly, to be obliged to despise ourselves, whenever we can command a moment's reflection!

In this state of darkness and illusion, we would willingly change the nature of the soul; she has been bestowed on us for the purposes of knowledge, and we would employ her only for those of sensation. If we could extinguish her light entirely, instead of regretting the loss, we would envy the condition of idiots. As we only reason by intervals, and as these intervals are burdensome to us, and pass in secret reproaches, we wish to suppress them. Thus proceeding always from illusion to illusion, we voluntarily seek to lose sight of ourselves, and to terminate the whole by forgetting our existence.

Uninterrupted passion is madness; and madness is the death of the soul. Violent passions, with intervals, are paroxysms of folly, diseases, of the mind, whose danger consists in their frequency and duration. Wisdom is only the sum of these intervals of health which we enjoy between the paroxysms of passion, and this sum is not entirely made up of happiness; for we then perceive that the mind has been diseased; we accuse our passions; we condemn our actions. Folly is the germ of misery, which wisdom unfolds. Most people who call themselves unhappy, are passionate men, or in other words, fools, who have some intervals of reason, during which they perceive their folly, and of course feel their misery: and as in the elevated conditions of life, there are more false appetites, more vain pretensions, more disordered passions, more abuse of the mind, than in the inferior, men of birth and opulence must unquestionably be the most unhappy.

But let us turn from these melancholy objects, these humiliating truths, and consider the wise man who alone merits examination. Occupied perpetually in exercising the faculties of his mind, he improves his understanding, cultivates his genius, and acquires fresh sources of knowledge: to the pleasures of the body, which he possesses in common with the other animals, he joins those of the mind, that are peculiar to him. He has two modes of being happy, which mutually aid and fortify each other; and if by disease or accident he be afflicted with pain, he suffers less than the fool: even in suffering pain, he has the pleasure of perceiving that he is enabled to endure it.

Health in man, is more feeble and precarious than in any other animal. He is oftener sick; his sickness is of longer duration; and he dies at every age. The brutes, on the contrary, seem to run through the space allotted to their existence with firm and equal steps. This circumstance appears to proceed from two causes, which though very different, mutually contribute to produce the same effect. The first is the agitation of mind occasioned by the derangement of our internal material sense. The passions have an influence on health, and introduce disorder into the vital principles. The majority of men lead either a timid or contentious life, and most of them die of chagrin. The second is the imperfection of those of our senses which are analogous to appetite. The brute animals distinguish better what is agreeable to their nature: they are never deceived in the choice of their aliment; they never exceed in their pleasures; guided by the perception of

their actual wants only, they remain satisfied, and never search for new sources of gratification. But man, independent of wishing for excess in every article, independent of that ardour with which he seeks to destroy himself by attempting to force Nature, is not so alert in distinguishing the effects of particular species of food. He despises simple aliment, and prefers compounded dishes, because his taste is corrupted, and because he has converted the sense of pleasure into an instrument of debauchery, which can only be gratified by irritation.

It is not therefore surprising that we are more subject to diseases than the brutes, since we cannot, like them, distinguish so easily what is noxious or salutary to our frame. Our experience in this article is less certain than their sentiment. Besides we even abuse those sensations of appetite, which they possess in a more perfect degree: in brutes, these sensations are the means of health and preservation; but in man, they become the causes of malady and destruction. Intemperance alone is more fatal to man than the united force of all the other evils incident to human nature.

By these considerations we are led to believe, that the feelings of animals are more determined and more exquisite than ours; for though it were allowed that brutes frequently poison themselves, it must likewise be granted, that they never take poison but when concealed among other food, or when so pressed with hunger that they eat whatever is presented to them; and many instances have occurred where animals have perished for want, rather than eat what was repugnant to their constitution.

The superior strength of sentiment in brutes may be still farther proved, by attending to their sense of smelling, which in most animals is so powerful, that they smell farther than they see: they not only scent actual objects at a distance, but they can trace them by their effluvia, long after they are gone. Such a sense is an universal organ of perception; it is an eye that sees objects, not only where they are, but where they have been. In a word, it is a sense by which the animal is enabled to distinguish with certainty what is agreeable to its nature, and by which it perceives what is fitted to gratify its appetite. Hence brute animals enjoy in a superior degree, the senses relative to appetite; and of course have feelings more exquisite than those of men. They are likewise conscious of their actual existence; but retain no consciousness of their past existence. This latter proposition, as well as the first, merits consideration.

In man, consciousness of existence is composed of the perception of actual existence, as well as remembrance of past existence. Remembrance is a perception equally present with the first impression; it even sometimes affects us more strongly than actual sensations. As these two species of sensation are different, and as the mind has the faculty of comparing and forming ideas from them, the consciousness of our existence is more certain and extensive, in proportion to the number and frequency of past objects recalled by the memory, and to the frequent combining and comparing of them with each other, and with present objects. Each object is accompanied with a certain number of sensations, or different existences, relative to the different states in which it was originally perceived. This number of sensations, by the comparison made between them by the mind, becomes a succession or train of ideas. The idea of time, and indeed every other idea, originates from the comparison of our sensations. But this train of ideas, or of existences, often presents itself to us in an order or arrangement very different from that in which our sensations were received. It is the arrangement of our ideas that we perceive, and not the order of our sensations; and in this consist chiefly the differences of character and of genius; for two men, though similar in organization, and educated in the same manner, and though they received their sensations in the same order, might notwithstanding think very differently. As the temperament of their minds was not the same, and as each combined and compared similar sensations in a manner peculiar to himself, the general results of these comparisons, or the ideas, genius, and character acquired, would likewise be different.

Some minds are peculiarly active in comparing sensations and forming ideas. Such men are always the most ingenious, and if not prevented by circumstances, make the most brilliant figure in life. There are others whose minds being more obtuse, allow every sensation to escape but such as make strong impressions: these men have less genius and vivacity than the former. Lastly, there are other men, and these constitute the multitude, who have so little activity of mind, and so great an aversion to thinking, that they never compare or combine sensations, at least, quickly. The sensations must be strong, and repeated a thousand times, before their minds can be roused to compare them or to form ideas. These men are exceedingly stupid, and differ from the brutes only by the small number of ideas which their minds have formed with so much labour.

The consciousness of our existence being thus composed not only of our actual sensations, but of the train of ideas which results from a comparison of our sensations, and of our past existence, it is evident that the more ideas a man possesses, he is more certain of his existence; that his existence is proportioned to his genius; and that by the power of reflection alone, we are conscious of our former existence, and that we will continue to exist, the idea of future being only the inverse comparison of the present with the past; for, in this view, the present is past, and the future present.

Now the power of reflection being denied to brutes,

it is obvious that they cannot form ideas, and consequently that the consciousness of their existence must be less certain and less extensive than ours; for they have no idea of time, no knowledge of the past or of the future. Their consciousness of existence is simple; it depends solely on the sensations which actually affect them, and consists of the internal feelings produced by these sensations.

We may perhaps acquire some notion of the consciousness of existence which animals possess, by reflecting on our own condition when strongly occupied with any object, or so violently agitated with passion as to preclude every reflex idea of ourselves. This condition is expressed by saying a man is absent or out of himself. We are out of ourselves when fully immersed in actual sensations, and especially when these sensations are violent, rapid, and leave the mind no leisure to reflect. In this state we feel every degree of pleasure and pain; we even retain the consciousness of our existence without any sensible participation of the mind. This condition, in which we have momentary impressions of our existence only, is the habitual state of animals; deprived of ideas, and furnished with sensations, they know not their existence but they feel it.

To illustrate this difference more fully let us compare the powers and actions of brute animals with those of man. Like us, they have senses and receive impressions from external objects. They have also an internal sense, an organ which retains the vibrations excited by these impressions; and consequently sensations, which, like ours, may be renewed, and are more or less strong and durable. Still however they have neither imagination, understanding, nor memory; because they possess not the power of comparing their sensations, and because these three faculties of the mind depend upon this power.

Have brute animals no memory? The contrary, I shall be told, is demonstrably evident: do they not recollect, after long absence, the persons with whom they have lived, the places where they dwelt, the roads they frequented? Do they not remember the chastisements they had suffered, the caresses they had received, the lessons they had been taught? Every thing concurs in showing that, though deprived of imagination and reason, they possess an active, extensive, and perhaps more faithful memory than our own. But, however striking these appearances may be, and however strong the prejudices to which they have given rise, I imagine it is capable of demonstration that they are deceitful, and that brutes have no knowledge of past events, no idea of time, and of course no memory.

In man memory originates from the faculty of reflection; for our remembrance of past events supposes not only a continuation of the impressions made upon the internal material sense, or a renewal of former sensations, but likewise the comparison the mind makes between its sensations or the ideas it forms. If memory consisted not in the renovation of past sensations, these sensations would be represented in our internal sense, without leaving any determined impressions; they would be exhibited without order or connection, like the ravings of persons mad or intoxicated, where objects are so deranged and confused, that no remembrance of them is retained; for we cannot remember things that have no relation to those which have preceded or followed them. No isolated sensation, however strong, can leave any traces on the mind. Now it is the mind alone that ascertains the relations of objects, by the comparison it makes between them, and connects our sensations by a continued train of ideas. Memory therefore consists in a succession of ideas, and necessarily supposes the existence of the power by which they are produced.

But to leave no room for doubt on this important point, let us examine that species of remembrance left by our sensations when unaccompanied with ideas. Pain and pleasure are sensations of the purest and strongest kind; yet our recollection of these feelings is feeble and confused. We only remember that we felt pleasure or pain; but our remembrance is indistinct: we cannot figure either the species, the degree, or the duration of those feelings which affected us so powerfully; and still less are we able to have clear ideas of those which have been seldom repeated. A violent pain, for example, which is felt but once, continues only a few moments, and differs from all former pains, would necessarily be soon forgot. We might recollect that we felt a great pain; but while we distinctly remembered the circumstances which attended it, and the time when it happened, we would have only a faint impression of the sensation itself.

Why is every thing that passed in our infancy entirely obliterated? Why do old men recollect what happened in their youthful years better than what occurred during their old age? Can there be a stronger proof that sensations alone are insufficient for the production of memory, and that it has no existence but in the train of ideas which the mind forms from its sensations? In infancy our sensations are perhaps as lively and rapid as in middle age; yet they leave little or no traces behind them; because at this period the power of reflection, which alone forms ideas, is almost totally inactive; and when it does act, its comparisons are superficial, and it is incapable of reducing objects to any regular arrangement. At the age of maturity reason is fully unfolded, because the power of reflection is at its meridian. We then derive from our sensations all the fruit they can produce, and we form various orders of ideas and chains of thought, each of which, by being frequently revolved, makes an impression so deep and indelible, that when

old age arrives the same ideas recur with more force than those derived from present sensations; because at that period our sensations are slow and feeble, and the mind itself participates in the languor of the body. Infancy is totally occupied with the present time: in mature years we enjoy equally the past, the present, and the future; and in old age we have but slight feelings of the present, we turn our eyes to futurity, and live only in the past. Do not these differences depend entirely on the arrangement the mind has made of its sensations; and are they not more or less connected with the faculty we possess at different ages of forming, acquiring, and retaining ideas? Neither the prattling of the child, nor the garrulity of old age, have the tone of reasoning, because they are equally deficient in ideas; the first is yet unable to form them, and the last has lost that faculty.

An idiot, whose senses and bodily organs appear to be perfectly sound, possesses in common with us every kind of sensation, and if he lived in society and were obliged to act like other men he would possess them in the very same order. But as these sensations give rise to no ideas; as there is no correspondence between his mind and his body; and as he has not the faculty of reflection; he is of course deprived of memory, and of all knowledge of himself. With regard to external powers this man differs not from the brutes; for though he has a soul, and possesses the principle of reason, as this principle remains inactive and receives no intelligence from the bodily organs, it can have no influence on his actions, which, like those of the brute animals, are determined solely by his sensations, and by the consciousness of his actual existence and present wants. Thus an idiot and a brute are beings whose operations are in every respect the same; because the latter has no soul, and the former makes no use of it; both want the power of reflection, and consequently have neither understanding, imagination, nor memory; but they both possess sensations, feelings, and the faculty of moving.

If it shall still however be asked, do not idiots and brutes often act as if they were determined by the knowledge of past objects? do they not recollect the persons with whom they have lived, the places where they dwelt, &c.? Do not these actions necessarily imply the exertions of memory? and does not this prove that memory flows not from the power of reflection?

The reader ought to recollect that I have already distinguished two species of memory, which, though they resemble each other in their effects, proceed from very different causes: the first is occasioned by the impressions of our ideas; and the second, which I would rather call reminiscence than memory, is only a renewal of our sensations, or of the vibrations that produced them. The first is an emanation of the mind, and as already remarked, is more perfect in man than the second. But the latter is only a renovation of the vibrations of the internal material sense; and it alone is possessed by idiots and brutes. Their former sensations are renewed by actual sensations; the principal and present recal the accessory and past images; they feel as they formerly felt, and consequently act as they formerly acted; they perceive the present and the past; but they have not the capacity of distinguishing or comparing objects, and of course have no proper knowledge of them.

I am aware that dreams will be adduced as another proof of the memory of brutes. It is undeniable that the objects which occupy animals when awake are likewise presented to them during sleep. Dogs bark in their sleep; and though this barking be feeble, it is easy to distinguish the sounds peculiar to the chase, to anger, to desire, to complaint, &c. It is therefore unquestionable that dogs have a lively and active memory, and very different from what has been above described, since it acts independent of external causes.

To obviate this difficulty we must examine the nature of dreams, and inquire whether they proceed from the mind, or depend solely on our internal material sense. If we can prove that they reside entirely in the latter, the objection will not only be removed, but a new argument will be furnished against the understanding and memory of brutes.

Idiots, whose minds are totally inactive, dream like other men: dreams therefore are produced independent of the mind. Brute animals, though they have no mind, not only dream, but I am tempted to think that all dreams are independent of the mind. Let any man reflect upon his dreams, and endeavour to discover why the parts of them are so ill connected, and the events so ridiculous and absurd. The chief reason, I have always thought, proceeds from this circumstance, that dreams are entirely derived from sensations and not from ideas. The idea of time, for example, never enters into dreams: persons whom we never saw are represented; we even see those who have been long dead in the same form as when they were alive; but they are always connected with present objects and persons, or with those which are past. It is the same with the idea of place: in dreams we never see persons where they are; objects must be seen where they are not, or they cannot be perceived at all. If the mind acted it would instantly reduce this chaos of sensations to order. But instead of acting, the mind generally allows these illusory representations to succeed each other in the order they occur; and though each object appears in lively colours, the succession is often confused, and always chimerical. If however the mind be half roused by the absurdity of the representations, or by the mere force of the sensations, a glimmering of light breaks in upon the darkness, and produces a real idea in the midst of chimeras; we then

begin to dream, or rather to think, that the whole may be only a dream. Though this action be only a feeble exertion of the mind, it is neither a sensation nor a dream; it is a real thought or reflection; but as it has not strength enough to dissipate the illusion, it mixes with, and becomes part of the dream, and allows the succession of images to proceed; so that when we awake, we imagine we have dreamed what we in reality thought.

In dreams we see much, but seldom understand: though we feel in the most lively manner we never reason: images and sensations succeed each other; but the mind never unites or compares them. We have therefore sensations, but no ideas; for ideas are the results of compared sensations. Hence dreams reside only in the internal material sense; they are produced without the intervention of the mind; and therefore constitute a part of that material or purely animal reminiscence which we have formerly mentioned. Memory, on the contrary, cannot exist without the idea of time, without the actual comparison of former ideas; and since ideas enter not into dreams, it is obvious that they can neither be a consequence, nor an effect, nor a proof of memory. But though ideas should sometimes accompany dreams, though the somnambulists, who walk, speak sensibly, answer questions, &c. in their sleep, should be quoted to prove that ideas are not so entirely excluded from dreams as I pretend, it is sufficient for my purpose, that dreams may be produced by the renewal of sensations alone, without the intervention of mind: for then brute animals can have dreams of this species only; and these dreams instead of supposing the existence of memory, indicate on the contrary, nothing more than a material reminiscence.

I am, however, far from believing that somnambulists are really occupied with ideas: the mind seems to take no part in their actions; for though they go about and return, they act without reflection or knowledge of their situation. They are neither conscious of the dangers nor inconveniences which accompany their expeditions. The animal faculties are alone employed, and even not the whole of them. A somnambulist, therefore, is in a more stupid state than that of an idiot; because he exerts a part of his senses only; but an idiot employs the whole, and enjoys extensively every species of feeling: and as to the people who speak during sleep, they never say any thing new. The answering some trivial questions, the repetition of some common phrases, prove not the action of the mind: all this may be performed independent of the thinking principle. Why may not a man asleep speak without thinking, since persons fully awake, especially when occupied with passion, utter many things without reflection?

With regard to the occasional cause of dreams, or the reason why former sensations are renewed, without being excited by present objects, it may be remarked, that we never dream during a profound sleep. Every thing is then extinguished; we sleep both externally and internally. But the internal sense sleeps last, and awakes first: because it is more active, and more susceptible of impressions than the external senses. We dream most, when our sleep is least perfect and profound. Former sensations, especially those which require no reflection, are renewed. The internal sense occupied with actual sensations, on account of the inactivity of the external senses, exercises itself with its past sensations. The strongest always present themselves first; and the stronger they are, the supposed situations become more keenly interesting. It is for this reason that dreams are almost perpetually either dreadful or ravishing.

It is not even necessary that the external senses should be absolutely lulled, before the internal sense can exert its independent powers: the simple inaction of these senses is sufficient to produce this effect. The habit of going to repose at stated times often prevents us from sleeping easily. The body and its members are softly extended without motion; the eyes are involved in darkness; the tranquillity of the place, and the silence of the night, render the ear useless; the other senses are equally inactive; all is in a state of repose, but nothing as yet entirely lulled or asleep. In this condition, and when the mind is also unoccupied with ideas, the internal material sense alone exerts itself. This is the season of illusive images and fleeting shades. We are awake, and yet we feel the effects of sleep. If we be in health and vigour, the succession of images and illusions is enchanting. But when the body is disordered or fatigued, the images are of a different nature: we are then tormented with hideous and threatening phantoms, which succeed each other with equal caprice and rapidity. This scene of chimeras may be called a magic lanthorn which fills the brain with illusions, when void of all other sensations: the objects of this scene are more lively, numerous, and disagreeable, in proportion to the weakness of the body and delicacy of the nerves; for the vibrations occasioned by real sensations being, in a state of weakness or disease, much stronger and more disagreeable than in a healthy state, the representations of these sensations, produced by a renewal of the same vibrations, must likewise be more lively and painful.

In fine, we remember dreams for the same reason that we remember former sensations: the only difference between us and the brutes is, that we can distinguish dreams from ideas or real sensations; and this capacity of distinguishing is a result of comparison, an operation of memory, which includes the idea of time. But the brutes, who are deprived of memory and of the faculty of comparing past and present time, cannot distinguish their dreams from their actual sensations.

In the article concerning the nature of man, I imagine

I have proved in a satisfactory manner, that animals possess not the power of reflection. Now the understanding, which is a result of this power, may be distinguished by two different operations: The first is the faculty of comparing sensations, and forming ideas from them; and the second is the power of comparing the ideas themselves, and forming a chain of reasoning. By the first operation we acquire particular ideas, or the knowledge of sensible objects: by the second we form general ideas, which are necessary for the acquisition of abstract truths. The brute animals possess neither of these faculties, because they have no understanding; and the understanding of the bulk of mankind seems to be limited to the first of the above operations.

If all men were equally capable of comparing and generalizing ideas, they would equally exhibit their ingenuity by new productions, which would be always different from those of others, and often more perfect; all men would be endowed with inventive powers, or at least with the capacity of improving and perfecting. But this is by no means the case: reduced to a servile imitation, most men execute only what they have seen performed by others; they think only from memory, and in the same order as others have thought; their understanding is limited entirely to form and imitation, and their power of reflecting is too feeble for invention.

Imagination is another faculty of the mind: if by imagination we understand the power of comparing images with ideas, of illuminating our thoughts, of aggrandizing our sensations, of painting our sentiments, in a word, of perceiving with rapidity all the qualities and relations of objects, this power is the most brilliant and most active faculty of the mind, and the brutes are still more devoid of it, than of either understanding or memory. But there is another species of imagination which depends solely on corporeal organs, and is common to us with the brutes, namely, that tumultuary emotion excited by objects analogous or opposite to our appetites, that lively and deep impression of the images of objects, which perpetually and involuntarily recurs, and forces us to act like the brutes, without deliberation or reflection. By this representation of objects, which is more active than their presence, every thing is exaggerated and painted in false colours. This species of imagination is the grand enemy of the human mind: it is the source of illusion, the mother of those passions, which in spite of the efforts of reason, rule over us, and render us the unhappy theatre of a perpetual combat, in which we are almost constantly vanquished.

The internal man is double. He is composed of two principles, different in their nature, and opposite in their action. The mind, or principle of all knowledge, wages perpetual war with the other principle, which is purely material. The first is a bright luminary, attended with calmness and serenity, the salutary source of science, of reason, and of wisdom. The other is a false light, which shines only in tempest and obscurity, an impetuous torrent, which involves in its train nothing but passion and error.

The animal principle is first unfolded. As it is purely material, and consists in the duration of vibrations, and the renewal of impressions formed in the internal material sense, by objects analogous or opposite to our appetites, it begins to act and to guide us, as soon as the body is capable of feeling pain or pleasure. The spiritual principle appears much later, and is unfolded and brought to maturity by means of education only: it is by the communication of others' thoughts alone that the child becomes a thinking and rational creature.

Let us view a child when left at full liberty, and removed from the observation of his guide. We may judge of what passes within him from his external actions. He neither thinks nor reflects. He follows indifferently every path to pleasure. He obeys all the impressions of external objects. He acts without reason. Like the young animals, he amuses himself by running and bodily exercise. He goes and returns, without design or preconceived project. His actions are desultory, and without order or connection. But when called upon by his parents, or those who have learned him to think, he instantly composes himself, gives a direction to his actions, and shows that he has retained the thoughts which had been communicated to him. The material principle has absolute sway during infancy, and would continue to reign through life, if the spiritual principle were not unfolded and put in motion by education.

It is easy by reflection, to perceive the existence of these two principles. There are moments, and even hours and days, in which we can distinguish with certainty both their existence and the contrariety of their action. I refer to those times of indolence, of fatigue, or disgust, when we are unable to form any determination, when our actions and desires are diametrically opposite; to that condition or disease called vapours, with which the sedentary and idle are so often affected. If we examine ourselves when in this state, we will seem to be divided into two distinct beings, the first of which, or the rational faculty, blames what is done by the second, but has seldom force enough to overcome it; the latter on the contrary, being composed of all the illusions of sense and imagination, commands, and often overpowers the former, and forces us to act contrary to our judgment, or makes us remain idle, though we have a desire of acting.

When the rational faculty reigns a man feels a tranquil possession of himself and his affairs; but he perceives at the same time that this is only acquirable by a kind of reluctant abstraction from the presence of the

other principle. But when the irrational principle assumes the dominion, we resign ourselves with ardour to dissipation, to appetite, and to passion, and hardly reflect upon the very objects which occupy us so entirely. In both these states we are happy; in the first, we command with satisfaction; and in the second, we have still greater pleasure in obeying. As only one of these principles is then in action, and is not opposed by the other, we are sensible of no internal conflict; our existence appears to be simple, because we feel but one impulse: it is in this unity of action that our happiness consists; for whenever reason accuses our passions, or when the violence of passion makes us hate the admonitions of reason, we then cease to be happy; we lose the unity of our existence, in which alone tranquillity consists; an internal conflict commences; the two persons oppose each other; and the two principles manifest themselves by producing doubts, inquietude, and remorse.

We may hence conclude that to be the most miserable of all states when these two sovereign powers of human nature exert equally their greatest efforts, and produce an equilibrium. This is that ultimate point of disgust which makes a man abhor himself, and leaves no other desire than that of ceasing to exist, no other power but that of arming with fury against himself.

What a dreadful condition! I have painted its darkest shade. But how many black clouds must precede? All the situations adjacent to this state of equilibrium must be replete with melancholy, irresolution, and misery. Even the body itself falls a victim to the agitations produced by these internal conflicts.

The happiness of man consists in the unity of his internal frame: during infancy he is happy because the material principle reigns alone, and is in perpetual action. The constraints, remonstrances, and even the chastisements of parents, affect not the basis of happiness in children. No sooner do they obtain their liberty than they resume all the spring and gaiety which they receive from the novelty and vivacity of their sensations. If a child were entirely left to himself his happiness would be complete; but it would cease, and be succeeded with a long train of misery. We are therefore obliged to lay him under certain restraints, which frequently make him uneasy; but these transitory pains are the germs of all his future good.

In youth when the mental principle begins to act, and might even serve for our guide, a new material sense springs up, and assumes such an absolute dominion over all our faculties, that the soul seems to yield itself a willing victim to the impetuous passions it excites. The material principle now gains a more complete command than it formerly possessed; for it not only subdues reason, but perverts it, and employs it as an instrument of gratification: we neither think nor act, but with a view to approve and to satisfy this passion. As long as this intoxication continues we are happy: external opposition and difficulties seem to corroborate the unity of this internal principle; they fortify the passion; they fill the intervals of languor; they rekindle the flame, and turn all our views to the same object, and all our powers towards the accomplishment of the same end.

But this happy scene passes away like a dream; the charm vanishes; and disgust and a frightful void succeed the plenitude of agreeable feelings with which we had been occupied. The mind, when roused from this lethargy, recognises itself with difficulty. It has lost by slavery the habit of commanding, together with its strength. It even loves servitude, and goes in quest of a new tyrant, a fresh object of passion, which in its turn soon disappears, and is succeeded by another whose duration is still shorter. Thus excess and disgust continue to multiply; pleasure flies from our embrace; the organs are debilitated; and the material sense, in place of governing, has not even the power to obey. After a youth spent in this manner nothing remains but an enervated body, a feeble and effeminate mind, and a total incapacity of employing either.

It has been remarked, that in the middle period of life men are most subject to those languors of mind, that internal malady which is distinguished by the name of vapours. At this age we still search after the pleasures of youth. This is the effect of habit, and not of any natural propensity. In proportion as we advance in years, instead of pleasure we more frequently feel the incapacity of enjoyment. Our desires are so often contradicted by our weakness, that we condemn both our actions and the passions which we wish in vain to gratify.

It is besides at this age that cares and solicitude arise; we then assume a certain state, or in other words, either from chance or choice, we enter upon a particular course of life, which it is always shameful to abandon, and often dangerous to pursue. We proceed therefore between two rocks equally formidable, contempt and aversion. The efforts we make to avoid them weaken our powers, and throw a damp upon our spirits; for after long experience of the injustice of men, we acquire the habit of regarding every individual as necessarily vicious; and after we are accustomed to prefer our own repose to the opinions of the world, and after the heart, rendered callous by the frequent wounds it has received, has lost its sensibility, we easily arrive at that state of indifference, that indolent tranquillity, of which we would formerly have been ashamed. Ambition, the most powerful motive of elevated minds, which is regarded at a distance as the noblest and most desirable of all objects, and which stimulates us to the performance of great and useful actions, has no attractions to those who have approached it, and proves a vain and deceitful

phantom to those who fall behind in the pursuit. Indolence takes place of ambition, and seems to offer all men an easier acquisition of more solid good. But it is preceded by disgust, and followed by languor, that dreadful tyrant of thinking minds, against which wisdom has less influence than folly.

It is hence apparent that the difficulty of reconciling man to himself originates from his being composed of two opposite principles; and that this is the source of his inconstancy, irresolution, and languor.

. Brute animals, on the contrary, whose nature is simple and purely material, feel no internal conflicts, no remorse, no hopes, no fears.

If we were deprived of understanding, of memory, of genius, and of every faculty of the soul, nothing would remain but the material part, which constitutes us animals. We would still have wants, sensations, pleasure, pain, and even passions; for what is passion but a strong sensation which may every moment be renewed? Now our sensations may be renewed in an internal material sense; we would therefore possess all the passions, at least all those which the mind, or principle of intelligence, can neither produce nor foment.

But the great difficulty is to distinguish clearly the passions peculiar to man from those which are common to him and the brutes. Is it certain, or even probable, that the animals have passions? Is it not on the contrary agreed, that every passion is a strong emotion of the mind? Ought we not therefore to search somewhere else than in the spiritual principle for the seeds of pride, of envy, of ambition, of avarice, and of all the other passions which govern us?

To me it appears that every thing which governs the mind is extraneous to it; that the principle of intelligence is not the principle of sentiment: that the seeds of the passions exist in our appetites; that all illusions proceed from the senses, and reside in our internal material sense; that at first the mind has no participation in these illusions but by its silence; and that when the mind does give any countenance to them it is subdued, and when it assents it is totally perverted.

Let us then distinguish man's physical from his moral passions: the one is the cause; the other the effect. The first emotion originates in the internal material sense: the mind may receive, but it cannot produce this emotion. Let us likewise distinguish instantaneous emotions from those that are durable, and we shall at once perceive that fear, horror, anger, love, or rather the desire of enjoyment, are sensations, which, though durable, depend solely on the impressions of objects upon our senses, combined with the subsisting impressions of our former sensations; and consequently that those passions must be common to us and the other animals: I say that the actual impressions of objects are combined with the subsisting impressions of our former sensations; for nothing is horrible or alluring, either to man or the brutes when seen for the first time. This is fully proved by experience: a young animal will run into the flames the first time a fire is presented to it. Animals acquire experience only by reiterated acts, the impressions of which remain in their internal sense; and though their experience be not natural, it is not less sure, and even renders the animal more circumspect; for a great noise, a violent motion, an extraordinary figure, suddenly and for the first time seen or presented, produce in the animal a shock, the effect of which resembles the first impressions of fear: but this feeling is instantaneous; and as it cannot be combined with any former sensation, it can only excite a momentary vibration, and not a durable emotion, which the passion of fear necessarily implies.

A young inhabitant of the forest, when suddenly struck with the sound of a hunter's horn, or with the report of a gun, starts, bounds, and flies off, solely from the violence of the shock which he felt. But if this noise ceases, and has been attended with no injury, the animal recognises the ordinary silence of nature; he composes himself, stops, and returns to his peaceable retreat. But age and experience soon render him timid and circumspect. If he feels himself wounded or pursued, after hearing a particular sound, the painful sensation is preserved in his internal sense; and whenever he again hears the same noise, the painful sensation is renewed, and combining with the actual impression, produces a durable passion, a real fear; the animal flies with all his speed, and often abandons for ever his former abode.

Fear then is a passion of which brute animals are susceptible, though they feel not our rational or foreseen apprehensions. The same remarks are applicable to horror, anger, and love; though brutes have none of our reflex aversions, our durable resentments, or our constant friendships. Brute animals possess all those primary passions which suppose no intelligence, no ideas, and are founded only on the experience of sentiment, or repeated feelings of pleasure and pain, and a renewal of former sensations of the same kind. Anger, or natural courage, is remarkable in those animals who have exerted their strength, and found it superior to that of others. Fear is the offspring of weakness; but love is common to all animals. Love is an innate desire, the soul of nature, the inexhaustible fountain of existence, the germ of perpetuity infused by the Almighty into every being that breathes the breath of life. It softens the most ferocious and obdurate hearts, and penetrates them with a genial warmth. It is the source of all good; by its attractions it unites the most savage and brutal tempers, and gives birth to every pleasure. Love! Thou divine flame! Why dost thou constitute the happiness of every other being, and bring misery to man alone? Because

this passion is only a physical good. Notwithstanding all the pretences of lovers, morality is no ingredient in the composition of love. Wherein does the morality of love consist? in vanity; the vanity arising from the pleasure of conquest, an error which proceeds from our attempts to exalt the importance of love beyond its natural limits; the vanity of exclusive possession, which is always accompanied with jealousy, a passion so low, that we uniformly wish to conceal it; the vanity proceeding from the mode of enjoyment, which only multiplies efforts, without increasing our pleasures. There is even a vanity in relinquishing the object of our attachment, if we first wish to break it off. But if we are slighted, the humiliation is dreadful, and after discovering that we have been long duped and deceived, turns into despair.

Brute animals suffer none of these miseries. They search not after pleasure where it is not to be found. Guided by sentiment alone, they are never deceived in their choice. There desires are always proportioned to the power of gratification. They relish all their enjoyments, and attempt not to anticipate or diversify them. But man, by endeavouring to invent pleasures, destroys those which correspond to his nature; by attempting to force sentiment, he abuses his being, and creates a void in his heart which nothing can afterwards fill up.

Thus every thing that is good in love belongs to the brutes as well as to man; and as if this passion could never be pure, the animals even seem to feel a small portion of jealousy. Jealousy in the human species always implies some distrust of ourselves, a tacit acknowledgment of our own weakness. The animals, on the contrary, seem to be jealous in proportion to their force, ardour, and habits of pleasure; because our jealousy proceeds from ideas, and theirs from sentiment. They have enjoyed, and they desire to enjoy more. They feel their strength, and they beat off all who endeavour to occupy their place. Their jealousy is not the effect of reflection. They turn it not against the object of their love. They are only jealous of their pleasures.

But are animals limited solely to those passions we have described? Are fear, anger, horror, love, and jealousy, the only permanent affections they are capable of feeling? To me it appears, that independent of these passions, of which natural sentiment, or rather the experience of sentiment, renders animals susceptible, they possess other passions, which are communicated to them by education, example, habit, and imitation. They have a species of friendship, of pride, and of ambition. And though, from what has been said, it is apparent that the operations they perform are not the effects of thought or reflection; yet as the habits we have mentioned seem to suppose some degree of intelligence, and to form the shade between man and the brute creation, this subject merits a careful examination.

Can any thing exceed the attachment of a dog to his master? Some of them have been known to die on the tomb in which he had been laid. But (not to quote prodigies or heroes) with what fidelity does the dog attend, follow, and protect his master! With what anxiety does he seek his caresses! With what docility and alacrity does he obey him! With what patience does he suffer his ill humour, and even his chastisements, though often unjust! With what gentleness and humility does he endeavour to regain his favour! In a word, what agitation and chagrin does the dog discover when his master is absent; and what excess of joy on his return! In all these expressions, is it possible to mistake the genuine characters of friendship? Are these characters equally strong and energetic, even in the human species?

This friendship, however, is the same with that of a lady for her goldfinch, of a child for its toy, or a dog for its master. Both attachments are equally blind and void of reflection: that of animals is only more natural, because it arises from their wants; while that of the other is nothing but an insipid amusement, in which the mind has no share. These puerile attachments are kept alive by habit, and acquire all their strength from a vacancy of brain. A taste for whims, the worship of idols, and in a word, an attachment to inanimated objects, indicate the highest degree of stupidity; and yet there are many makers and worshippers of idols; and many are fond of the soil which they have tilled.

All attachments, therefore, are acquired without the intervention of the mind; for they uniformly arise when we think least, and they acquire force, and become habitual by want of reflection. If an object pleases our senses, we instantly love it; and if this object continues for some time to occupy our attention, we convert it into an idol.

But friendship necessarily implies the power of reflection. It is of all attachments the most worthy of man, and the only one which degrades not his nature. Friendship is the offspring of reason. The impressions of sense have no share in its production. It is the mind of our friend that we love; and to love a mind, implies that we have one, and that we have employed it in the investigation of knowledge, and in distinguishing the faculties of different minds. Friendship therefore supposes, not only the existence of an intelligent principle, but the actual exertions of this principle in reflecting and reasoning.

Thus friendship belongs only to man; and though the brutes may be allowed to have attachments, sentiment alone is sufficient to attach them to those whom they often see, and by whom they are fed and protected. It is still more sufficient to attach them to objects with which they are obliged to be much connected. The attachment of mothers to their young proceeds from their being long occupied in carrying them in the womb,

and in producing and suckling them. In some species of birds, the fathers seem to have an attachment for their offspring, and to provide for the mothers during incubation: this attachment originates from their being employed in building the nest, and from the pleasure they receive from the females, which continue in season long after impregnation. But in the other animals, whose season of love is short, whenever it is past, the males have no attachment to the females. Where there is no nest, no common operation to be performed, the fathers, like those of Sparta, have no regard to their posterity.

The pride and ambition of animals are effects of their natural courage, or of the sentiments arising from their strength, agility, &c. Large animals seem to despise the audacious insults of the smaller ones. Their courage and ardour are even capable of being improved by education and example; for they are susceptible of every thing except reason. In general, brute animals can learn to repeat the same action a thousand times, to perform in succession what they only did by intervals, to continue an action a long time, which they were accustomed to finish in an instant, to do voluntarily what at first was the effect of force, to perform habitually what they once executed by chance, and to do of their own accord, what they see performed by others. Of all the results of the animal machine, that of imitation is the most admirable. It is the most delicate, as well as the most extensive principle of action, and makes the nearest approach to thought: and though in animals, the cause of it be purely material, its effects have always been astonishing. Men never admired the apes till they saw them imitate human actions. It is not indeed an easy matter to distinguish some copies from the originals. There are besides, so few who can clearly perceive the difference between genuine and counterfeit actions, that to the bulk of mankind, the apes must always excite surprise and humiliation.

The apes, however, are more remarkable for talents than genius. Though they have the art of imitating human actions, they are still brutes, all of which in various degrees, possess the talent of imitation. This talent in most animals is entirely limited to the actions of their own species. But the ape, although he belongs not to the human species, is capable of imitating some of our actions. This power, however, is entirely the effect of his organization. He imitates the actions of men, because his structure has a gross resemblance to the human figure. What originates solely from organization and structure, is thus ignorantly ascribed, by the vulgar to intelligence and genius.

By the relations of motion, a dog learns the habits of his master; by the relations of figure, an ape mimics human gestures: and by the relations of organization, a goldfinch repeats musical airs, and a parrot imitates speech, which forms the greatest external difference between one man and another, and between man and the other animals; for by means of language one man discovers a superiority of knowledge and genius, while others express by it nothing but confused or borrowed ideas; and in an idiot, or in a parrot, it serves only to mark the last degree of stupidity, the incapacity, in either, to produce thought or reflection, though both be endowed with proper organs for expressing what passes within them.

It is still easier to prove that imitation is a result of mere mechanism. The most perfect imitation depends on the vivacity with which the internal material sense receives the impressions of objects, and the facility of expressing them by the aptness of external organs. Men whose senses are most delicate and easily affected, and whose members are most agile and flexible, make the best actors, the best mimics, the best monkeys. Children, insensibly, and without reflection, imitate the actions, the gestures, and the manners of those with whom they live: they are extremely alert in repeating and counterfeiting. Most young people, though they see with the eyes of the body only, are very dexterous in perceiving ridiculous figures. They are struck with every strange form or new representation. The impression is so strong that they relate it with enthusiasm, and copy it with ease and with gracefulness. Children, therefore, possess in a superior degree, the talent of imitation, which supposes more perfect organs, and a more happy disposition of members, to which nothing is so repugnant as a large portion of good sense.

Thus among men, those who reflect least, have generally the strongest imitative talents. It is not therefore surprising, that this talent should appear in those animals who have no reflection. They ought even to possess it in the highest degree of perfection, because they have nothing to oppose its operation, no principle to excite a desire of differing from each other. Among men, all the diversity of character and variety of action proceed entirely from the mind. But brute animals who have no mind, and consequently are destitute of that principle which can alone give rise to variety of character, or of personal accomplishments, must, when they resemble each other in organization, or are of the same species, do the same things in the same manner, and imitate one another more perfectly than one man can imitate the actions of another man. Of course, the talent of imitation possessed by the brute animals, so far from implying thought or reflection, proves that they are absolutely deprived of both.

It is for the same reason that the education of animals, though short, is always successful. They soon acquire by imitation, all the knowledge of their parents. They not only derive experience from their own feelings, but by means of imitation, they learn the experience acquired

by others. Young animals model themselves entirely upon the old: they see the latter approach or fly, when they perceive particular objects, hear certain sounds, or smell certain odours. At first they approach or fly without any other determining principle but that of imitation; and afterwards they approach or fly of their own accord, because they have then acquired the habit of flying or approaching, whenever they feel the same sensations.

Having thus compared man with the brutes, when taken individually, I shall now compare man in society with the gregarious tribes, and endeavour to investigate the cause of that species of industry which is so remarkable in some animals, even of the lowest and most numerous orders. What marvellous feats are not daily ascribed to certain insects? The talents and wisdom of the bee are admired with envy: they are said to possess an art peculiar to themselves, the art of perfect government. A bee-hive, say the eulogists of this insect, is a republic where every individual labours for the community, where every thing is distributed and arranged with a foresight, an equity, and a prudence that is truly astonishing: the policy of Athens itself was not more perfect or better conducted: the more we examine these insects they exhibit fresh objects of admiration; an unalterable and uniform system of government, a profound respect for the sovereign, an anxious attention to her welfare and inclinations, an ardent love to their country, an incredible assiduity in labouring for the public good, the greatest disinterestedness, joined to the strictest œconomy, the finest geometry, combined with the most elegant architecture, &c. But were I to run over the annals of this republic, and to retail all the incidents in the œconomy of these insects, which have excited the admiration of their historians, I should never come to an end.

Independent of that attachment which men acquire for their favourite subjects, the more they observe and the less they reason, their admiration is proportionally augmented. Can any thing be more gratuitous than this blind admiration of bees, than the pure republican principles ascribed to them, than that singular instinct which rivals the most sublime geometry, which solves without hesitation the difficult problem of *building in the most solid manner, in the least possible space, and with the greatest possible œconomy!* These eulogies are not only excessive but ridiculous: a bee ought to hold no higher rank in the estimation of a naturalist than it actually holds in nature. This wonderful republic therefore must always appear in the eye of reason to be only an assemblage of small animals, which have no other relation to man but that of furnishing him with wax and honey.

I here blame not curiosity, but absurd exclamation and false reasoning. To examine the operations of bees, to observe the progress of their labours, to describe their generation, their metamorphoses, &c. these are objects worthy the attention of philosophers. But it is the morality, and even the theology ascribed to insects that I cannot hear with patience: it is the marvellous feats first invented, and then extolled by naturalists, which I wish to examine: it is the intelligence, the foresight, and even the knowledge of futurity, which have with so much exaggeration been falsely lavished upon them, that I must endeavour to reduce them to their just value.

The genius of solitary bees, it is allowed on all hands, is vastly inferior to that of the gregarious species; and the talents of those which associate in small troops are less conspicuous than of those that assemble in numerous bodies. Is not this alone sufficient to convince us, that the seeming genius of bees is nothing but a result of pure mechanism, a combination of movements proportioned to numbers, an effect which appears to be complicated, only because it depends on thousands of individuals? Has not every congruity, and even disorder itself, the appearance of harmony, when we are ignorant of the cause? From apparent order to actual intelligence there is but one step; for men are always more disposed to admire than to reason.

It must therefore be admitted, that bees, taken separately, have less genius than the dog, the monkey, and most other animals: it will likewise be admitted that they have less docility, less attachment, and less sentiment; and that they possess fewer qualities relative to those of the human species. Hence we ought to acknowledge that their apparent intelligence proceeds solely from the multitude united. This union however presupposes not intellectual powers; for they unite not from moral views: they find themselves assembled together without their consent. This society therefore is a physical assemblage ordained by nature, and has no dependence on knowledge or reasoning. The mother bee produces at one time, and in the same place ten thousand individuals, which, though they were much more stupid than I have supposed them, would be obliged solely for the preservation of their existence, to arrange themselves into some order. As they all act against each other with equal forces, supposing their first movements to produce pain, they would soon learn to diminish this pain, or in other words, to afford mutual assistance: they of course would exhibit an air of intelligence, and of concurring in the accomplishment of the same end. A superficial observer would instantly ascribe to them views and talents which they by no means possess: he would explain every action: every operation would have its particular motive, and prodigies of reason would arise without number; for ten thousand individuals, produced at one time, and obliged

to live together, must all act in the very same manner; and if endowed with feeling, they must acquire the same habits, assume that arrangement which is least painful or most easy to themselves, labour in their hive, return after leaving it, &c. Hence the origin of the many wonderful talents ascribed to bees, such as their architecture, their geometry, their order, their foresight, their patriotism, and in a word, their republic, the whole of which, as I have proved, has no existence but in the imagination of the observer.

Is not nature herself sufficiently astonishing without ascribing to her miracles of our own creation? Are not the works of the Almighty sufficient to demonstrate his power? and do we imagine that we can enhance it by our weakness? If possible, this is the very way to degrade his perfections. Who gives the grandest idea of the supreme Being; he who sees him create the universe, arrange every existence, and found nature upon invariable and perpetual laws; or he who inquires after him, and discovers him conducting and superintending a republic of bees, and deeply engaged about the manner of folding the wings of a beetle?

Some animals unite into societies which seem to depend on the choice of those that compose them, and consequently make a nearer approach to intelligence and design than that of the bees, which has no other principle than physical necessity. The elephants, the beavers, the monkeys, and several other species of animals, assemble in troops, for defending each other, and for the purpose of carrying on some common operations. If these societies were less disturbed, and if they could be observed with equal ease as that of the bees, we should doubtless discover wonders of a very different nature, which notwithstanding would be only effects of physical laws. When a multitude of animals of the same species are assembled in one place, a particular arrangement, a certain order, and common habits, must be the necessary results. Now every common habit, so far from having intelligence for its cause, implies nothing more than a blind imitation.

Society among men depends less upon physical than moral relations. His weakness, his wants, his ignorance, and his curiosity, soon taught him the necessity of associating: he soon found that solitude was a state of war and of danger; and he sought for safety, peace, and society. He augmented his own power and his knowledge by uniting them with those of his fellow-creatures. This union was the best use he ever made of his rational faculties. Man commands the universe solely because he has learned to govern himself, and to submit to the laws of society.

Every thing has concurred to render man a social animal: though large and polished societies certainly depend upon custom, and sometimes on the abuse of reason, they were unquestionably preceded by smaller associations, which had no basis but that of nature. A family is a natural society, which has deeper and more permanent foundations, because it is accompanied with more wants and more causes of attachment. Man differs from the other animals: when he comes into the world, he hardly exists. Naked, feeble, and incapable of action, his life depends on the aid of others. The weaknesses of infancy continue long. The necessity of support is converted into a habit, which of itself is capable of producing a mutual attachment between the child and its parents. But as the child advances, he gradually acquires more force, and has less need of assistance. The affection of the parents on the contrary continues, while that of the child grows daily less. Thus love descends more than it ascends. The attachment of the parent becomes excessive, blind, and invincible; and that of the child remains cold and inactive, till the seeds of gratitude are unfolded by reason.

Thus human society, even when confined to a single family, implies the existence of the rational faculty; that of gregarious animals, who seem to unite from choice and convenience, implies experience and sentiment; and that of insects, which, like the bees, are associated without design or motive, implies nothing at all. Whatever may be the effects of this latter association, it is clear that they have neither been foreseen nor conceived by the creatures which produced them, and that they result solely from universal laws of mechanism established by the Almighty. Suppose ten thousand automatons assembled in the same place, all endowed with the same force, and determined by a perfect resemblance in their external and internal structure, and by a uniformity in their movements, to perform the same operaton, a regular work would be the necessary result. They would exhibit the relations of regularity, of resemblance, and of position; because these depend upon the relations of motion, which we have supposed to be equal and uniform. The relations of juxta-position, of extension, and of figure, would also appear; because we have supposed a given and circumscribed place: and if we bestow on these automatons the smallest degree of sensation, just as much is necessary to make them feel their existence, to have a tendency to self-preservation, to avoid what is hurtful, to desire what is agreeable, &c. their operations will be not only regular, proportioned, similar, and equal, but they will have the air of the highest symmetry, solidity, convenience, &c.; because in the process of their labours each of the ten thousand individuals has assumed that arrangement which was most commodious to itself, and has at the same time been obliged to act, and to arrange itself in the manner least incommodious to the rest.

Shall I enforce this argument still farther? The hexagonal cells of the bee, which have been the subject of so much admiration furnish an additional proof of the

stupidity or these insects: this figure though extremely regular, is nothing but a mechanical result, which is often exhibited in some of the most rude productions of Nature. Crystals, and several other stones, as well as particular salts, &c. constantly assume this figure. The small scales in the skin of the roussette, or great Ternate bat, are hexagonal, because each scale when growing obstructs the progress of its neighbour, and tends to occupy as much space as possible. We likewise find these same hexagons in the second stomach of ruminating animals, in certain seeds, capsules, flowers, &c. If we fill a vessel with cylindrical grain, and after filling up the interstices with water, shut it close up, and boil the water, all these cylinders will become hexagonal columns. The reason is obvious, and purely mechanical. Each cylindrical grain tends by its swelling to occupy as much space as possible; and therefore by reciprocal compression, they necessarily assume an hexagonal figure. In the same manner each bee endeavours to occupy as much space as possible, in the limited dimensions of the hive; and therefore as the bodies of the bees are cylindrical, they must necessarily make their cells hexagonal, from the reciprocal obstruction they give to each other.

The genius of bees has been estimated according to the regularity of their works. Bees are said to be more ingenious than wasps, hornets, &c.; for though the latter are acquainted with architecture, their fabrics are more rude and irregular. But it was not considered by the abettors of this opinion, that the greater or less regularity depends solely on the number and figure, and not on the intelligence of these creatures. In proportion to the greatness of the number, there are more equal and opposite forces in action, and of course, more mechanical restraint, and more regularity and apparent perfection in their works.

Those animals therefore who most resemble man in figure and organization, notwithstanding the eulogists of insects, will still remain superior to all others in their internal qualities: and though these qualities be infinitely different from those of man, though they are, as has been proved, the results of experience and feeling only; yet they greatly exceed the qualities of insects. As every operation of Nature is conducted by shades, or slight gradations, a scale may be formed for ascertaining the intrinsic qualities of every animal, by taking, for the first point, the material part of man, and by placing the animals successively at different distances, in proportion as they approach or recede from that point, either in external form, or internal organization. Agreeable to this scale, the monkey, the dog, the elephant, and other quadrupeds, will hold the first rank; the cetaceous animals, who like the quadrupeds consist of flesh and blood, and are viviparous, will hold the second; the birds the third, because they differ more from man than the quadrupeds or cetaceous animals; and were it not for oysters and polypi, which seem to be the farthest removed from man, the insects would be thrown into the lowest rank of animated beings.

But if the animals be deprived of understanding, of genius, of memory, and of all intelligence; if their faculties depend on their senses, and be limited entirely to the exercise of experience and of feeling, how can we account for that species of foresight which some of them seem to possess? Could feelings alone determine them to amass provisions in summer to nourish them during the rigours of winter? Does not this imply a comparison of time, a rational anxiety concerning their future comfort and subsistence? Why do birds build nests, if they know not that they will be useful for depositing their eggs and rearing their young? It is unnecessary to multiply facts of the same nature.

Before solving these questions, or reasoning concerning the above and similar facts, it is necessary to ascertain their reality: instead of being retailed by lovers of the marvellous, if they had been examined by men of sense and collected by philosophers, I am persuaded that all these pretended miracles would have soon disappeared, and that by cool and dispassionate reflection, the cause of each particular fact might have been discovered. But let us admit the truth of all these facts; let us allow to the animals foresight, and even a knowledge of the future, can this be ascribed to their intellectual powers? If this were really the case, their intelligence would be greatly superior to ours: for our foresight is entirely conjectural; our notions concerning futurity are always doubtful, and founded on probabilities. Hence brute animals, who see the future with certainty, since they determine before hand and are never deceived, would be endowed with a principle of knowledge superior to the human mind. I ask, whether this conclusion be not equally repugnant to religion and to reason.

It is impossible therefore that the brutes have a certain knowledge of the future from an intellectual principle similar to ours. Why then ascribe to them upon such slight grounds, a quality so sublime? Why unnecessarily degrade the human species? Is it not less unreasonable to refer the cause to mechanical laws, established like the other laws of Nature, by the will of the Creator? The certainty with which animals are supposed to act, and the stability and uniformity of their determinations, sufficiently evince them to be the effects of pure mechanism. To doubt, to deliberate, to compare, are the essential characters of reason. But movements and actions which are always decisive, and always certain, indicate at the same time both mechanism and stupidity.

But as the laws of Nature are general effects only, and as the facts in question are limited and particular,

it would be less philosophic, and more unworthy, of the ideas we ought to entertain of the Creator, to embarrass his will thus gratuitously with a vast number of petty statutes, of which one must be enacted for bees, another for owls, a third for field-mice, &c. Should we not, on the contrary, exert all our efforts to reduce these particular effects to more general ones? And if that be impossible, let us record them, and wait patiently till new facts and new analogies enable us to investigate their causes.

Let us however examine if these facts be so inexplicable and so marvellous, or even if they be properly authenticated. The foresight ascribed to ants is now discovered to be a vulgar error. They remain in a torpid state during winter. Their provisions therefore are only a superfluous mass, collected without design, and without any knowledge of the future; for on the supposition of this knowledge, they would be endowed with the faculty of foreseeing what was perfectly useless. Is it not natural for animals that have a fixed abode, to which they are accustomed to transport their provisions, to collect more than they can consume? Is not feeling alone guided by the habit they have acquired of transporting their food, in order that they may use it in tranquillity, sufficient to account for this phœnomenon? Does not this demonstrate that they are only endowed with feeling, and not with reason? For the same reason bees collect more wax and honey than they can consume: man profits not therefore by their intelligence, but by their stupidity. Intelligence would necessarily determine them to collect no more than they could use, and to save themselves the trouble of amassing a superfluous quantity, especially after they learn from experience, that this labour is lost, that the overplus is uniformly taken from them, and that this abundance is the sole cause of the desolation and destruction of their society. What demonstrates this superfluous labour to be the effect of feeling alone is, that we can oblige them to work as much as we please. As long as there are flowers in any country, the bee continues to extract from them honey and wax. If bees were transported from one region to another, so as to afford them a constant succession of fresh flowers, their labours would never cease. The amassing disposition of the bee therefore is not an effect of foresight, but a movement produced by feeling; and this movement is continued as long as the objects which give rise to it exist.

I have bestowed particular attention on the œconomy of field-mice. Their holes are generally divided into two apartments; in one of them they deposit their young, and in the other every thing that is agreeable to their palates. When made by themselves, their holes are not large, and can receive a small quantity of provisions only: but when they find a large space under the trunk of a tree, there they take up their abode, and fill it with all the grain, nuts, &c. they can collect. Hence the quantity of provisions amassed, instead of being proportioned to the wants of the animal, depend entirely on the capacity of the place where they happen to be deposited.

Thus the provisions of the ant, of the field-mouse, and of the bee, are discovered to be only useless and disproportioned masses, collected without any view to futurity, and the minute and particular laws of their pretended foresight are reduced to the general and real law of feeling. The sagacity and foresight ascribed to birds originate from the same cause. To account for the construction of their nests, it is unnecessary to have recourse to a particular law established by the Almighty in their favour. To this operation they are led by degrees. They first find a proper place, and then bring materials to render it more commodious. The nest is only a place which they can distinguish from all others, and where they can live in tranquillity. Love is the sentiment that stimulates and directs them in this operation. The male and female require the aid of each other. They feel a strong mutual attachment; they endeavour to conceal themselves, and to retire from the rest of the world, which is now become more dangerous to them than ever. They therefore retreat to the forest, to places the most obscure and inaccessible; and to render their situation more comfortable, they collect straw, leaves, &c. and form them, with incessant labour, into a common habitation. Some less dexterous or less sensual, make coarse and rude nests; others, contented with what they find already made, have no other habitation than the holes they meet with, or the nests which are presented to them. All these operations are effects of organization, and depend upon feeling, which, however exquisite in degree, can never produce reasoning; and still less can it produce that intuitive foresight, that certain knowledge of futurity, which have been ascribed to the feathered tribes.

This doctrine may be farther proved by a few familiar examples. Birds, instead of knowing the future, are even ignorant of what is past. A hen cannot distinguish her own eggs from those of another bird. She perceives not that the young ducks whom she has hatched belong not to her. She broods over chalk eggs, from which nothing can be produced, with equal industry as if they were her own. She has no knowledge, therefore, either of the past or the future, and is still more deceived with regard to the present. Why do not domestic poultry make nests as well as other birds? Is it because the male belongs to many females? or rather, is it not because, being accustomed to be out of the reach of inconvenience and danger, they have no occasion to conceal themselves, no habit of seeking for safety in retreat and solitude? This admits of proof by facts; for wild birds of the same species perform actions

which are entirely neglected when in a domestic state. The wild duck and wood-hen build nests ; but none are made by these animals when in a domestic state. The nests of birds therefore, the cells of bees, the collections of food laid up by the ant, the field-mouse, &c. suppose not any intelligence in those animals, nor proceed from particular laws established for each species, but depend, like every other animal operation, on number, figure, motion, organization, and feeling, which are general laws of nature, and common to all animated beings.

It is by no means astonishing that man, who is so little acquainted with himself, who so often confounds his sensations and ideas, who so seldom distinguishes the productions of the mind from those of the brain, should compare himself to the brute animals, and make the only difference between them consist in the greater or less perfection of their organs : it is not surprising that he should make them reason, understand, and determine in the same manner with himself ; and that he should attribute to them not only those qualities which he possesses, but even those of which he is deprived. Let man however examine, analyse, and contemplate himself, and he will soon discover the dignity of his being ; he will perceive the existence of his soul ; he will cease to degrade his nature ; he will see, at one glance, the infinite distance placed by the Supreme Being between him and the brutes

God alone knows the past, the present, and the future. Man, whose existence continues but a few moments, perceives only these moments : but a living and immortal power compares these moments, distinguishes and arranges them. It is by this power that man knows the present, judges of the past, and foresees the future. Deprive him of this divine light, and you deface and obscure his being ; nothing will remain but an animal equally ignorant of the past and the future, and affectable only by present objects.

OF DOMESTIC ANIMALS.

MAN changes the natural condition of animals, by forcing them to obey and to serve him. A domestic animal is a slave destined to the amusement, or to aid the operations of men. The abuses to which he is too frequently subjected, joined to the unnatural mode of his living, induce great alterations both in his manners and dispositions. But a savage animal, obedient to nature alone, knows no laws but those of appetite and independence. Thus the history of savage animals is limited to a small number of facts, the results of pure nature. But the history of domestic animals is complicated, and warped with every thing relative to the arts employed in taming and subduing the native wildness of their tempers : and as we are ignorant what influence habit, restraint, and example, may have in changing the manners, determinations, movements, and inclinations of animals, it is the duty of the naturalist to examine them with care, and to distinguish those facts which depend solely on instinct from those that originate from education ; to ascertain what is proper to them from what is borrowed ; to separate artifice from nature ; and never to confound the animal with the slave, the beast of burden with the creature of God.

Man holds a legitimate dominion over the brute animals, which no revolution can destroy. It is the dominion of mind over matter ; a right of nature founded upon unalterable laws, a gift of the Almighty, by which man is enabled at all times to perceive the dignity of his being : for his power is not derived from his being the most perfect, the strongest, or the most dexterous of all animals. If he hold only the first rank in the order of animals, the inferior tribes would unite, and dispute his title to sovereignty. But man reigns and commands from the superiority of his nature : he thinks ; and therefore he is master of all beings who are not endowed with this inestimable talent. Material bodies are likewise subject to his power : to his will they can oppose only a gross resistance, or an obstinate inflexibility, which his hand is always able to overcome, by making them act against each other. He is master of the vegetable tribes, which by his industry he can at pleasure augment or diminish, multiply or destroy. He reigns over the animal creation ; because, like them, he is not only endowed with sentiment and the power of motion, but because he thinks, distinguishes ends and means, directs his actions, concerts his operations, overcomes force by ingenuity, and swiftnesss by perseverance.

Among animals however some are more soft and gentle, others more savage and ferocious. When we compare the docility and submissive temper of the dog with the fierceness and rapacity of the tiger, the one appears to be the friend, and the other the enemy of man. Thus his empire over the animals is not absolute.

Many species elude his power by the rapidity of their flight, by the swiftness of their course, by the obscurity of their retreats, by the element which they inhabit: others escape him by the minuteness of their bodies; and others, instead of acknowledging their sovereign, attack him with open hostility. He is likewise insulted with the stings of insects, and the poisonous bites of serpents; and he is often incommoded with impure and useless creatures, which seem to exist for no other purpose but to form the shade between good and evil, and to make man feel how little, since his fall, he is respected.

But the empire of God must be distinguished from the limited dominion of man. God, the creator of all being, is the sole governor of nature. Man has no influence on the universe, the motions of the heavenly bodies, or the revolutions of the globe which he inhabits. He has no general dominion over animals, vegetables, or minerals. His power extends not to species, but is limited to individuals; for species and the great body of matter belong to, or rather constitute nature. Every thing moves on, perishes, or is renewed by an irresistible power. Man himself, hurried along by the torrent of time, cannot prolong his existence. Connected by means of his body to matter, he is forced to submit to the universal law, and like all other organized beings, he is born, grows, and perishes.

But the ray of divinity with which man is animated ennobles and elevates him above every material existence. This spiritual substance, so far from being subject to matter, is entitled to govern it; and though the mind cannot command the whole of nature, she rules over individual beings. God, the source of all light and of all intelligence, governs the universe, and every species, with infinite power: man, who possesses only a ray of this intelligence, enjoys accordingly a power limited to individuals.

THE HORSE.

THE reduction of the horse to a domestic state is the greatest acquisition from the animal world which was ever made by the art and industry of man. This noble animal partakes of the fatigues of war, and seems to feel the glory of victory. Equally intrepid as his master, he encounters danger and death with ardour and with magnanimity. He delights in the noise and tumult of arms, and annoys the enemy with resolution and alacrity. But it is not in perils and conflicts alone that the horse willingly co-operates with his master; he likewise participates of human pleasures. He exults in the chace and the tournament; his eyes sparkle with emulation in the course. But though bold and intrepid, he suffers not himself to be carried off by a furious ardour; he represses his movements, and knows how to govern and check the natural vivacity and fire of his temper. He not only yields to the hand, but seems to consult the inclination of his rider. Uniformly obedient to the impressions he receives, he flies or stops, and regulates his motions entirely by the will of his master. He, in some measure, renounces his very existence to the pleasure of man. He delivers up his whole powers; he reserves nothing, and often dies rather than disobey the mandates of his governor.

These are features in the character of the horse whose natural qualities have been matured by art, and turned with care to the service of man. His education commences with the loss of liberty, and is completed by restraint. The slavery of the horse is so ancient and so universal that he is rarely seen in a natural state. When employed in labour he is always covered with the harness; and even during the time destined for repose, he is never entirely delivered from bonds. If sometimes permitted to roam in the pasture, he always bears the marks of servitude, and often the external impressions of labour and pain. His mouth is deformed by the perpetual friction of the bit; his sides are galled with wounds, or furrowed with cicatrices: and his hoofs are pierced with nails. The natural gestures of his body are constrained by the habitual pressure of fetters, from which it would be in vain to deliver him; for he would not be more at liberty. Those horses, the servitude of which is most mild, which are kept solely for the purposes of luxury and magnificence, and whose golden chains only gratify the vanity of their masters, are more dishonoured by the elegance of their trappings, and by the plaits of their hair, than by the iron shoes on their feet.

Art is always excelled by nature; and in animated beings liberty of movement constitutes the perfection of their existence. Examine those horses which have multiplied so prodigiously in Spanish America, and live in perfect freedom. Their motions are neither constrained nor measured. Proud of their independence, they fly from the presence of man, and disdain all his care. They search for and procure the food that is most salutary and agreeable. They wander and frisk about in immense meadows, and collect the fresh productions of a perpetual spring. Without any fixed habitation, or

other shelter than a serene sky, they breathe a purer air than in those musty vaults in which we confine them, when subjected to our dominion. Hence wild horses are stronger, lighter, and more nervous than most of those which are in a domestic state. The former possess force and dignity, which are the gifts of nature; the latter have only address and gracefulness, which are all that art can bestow.

These wild horses are by no means ferocious in their temper; they are only wild and fiery. Though of strength superior to most animals they never make an attack. But when assaulted, they either disdain the enemy, bounce out of his way, or strike him dead with their heels. They associate in troops from no other motive than the pleasure of being together; for they have no fear; but acquire a mutual attachment to each other. As grass and vegetables constitute their food, of which they have enough to satisfy their appetite, and as they are not carnivorous, they neither make war with other animals, nor among themselves. They dispute not about their common nourishment, and never have occasion to snatch prey from each other, the general source of quarrels and combats among the rapacious tribes. Hence they live in perpetual peace; because their appetites are simple and moderate, and they have no objects to excite envy.

All these features are apparent in young horses bred together in troops. Their manners are gentle, and their tempers social; their force and ardour are generally rendered conspicuous by marks of emulation. They anxiously press to be foremost in the course, to brave danger in traversing a river, or in leaping a ditch or precipice; and it has been remarked, that those which are most adventurous and expert in these natural exercises, are the most generous, mild, and tractable, when reduced to a domestic state.

Wild horses are mentioned by several ancient authors. Herodotus takes notice of white savage horses on the banks of the Hypanis in Scythia; and in the northern part of Thrace, beyond the Danube, he remarks, that there were wild horses covered all over with hair five inches long. Aristotle says, they were to be found in Syria; Pliny, in the northern regions; and Strabo, in Spain and the Alps. Among the moderns, Cardan says the same thing of Scotland and the Orkney isles; Olaus, of Muscovy; Dapper, of the island of Cyprus, where, he says, there were beautiful wild horses, of great strength and swiftness; and Struys, of the island of May, one of the Cape de Verds, where he saw wild horses of a small stature. Leo, of Africa, likewise relates, that there were wild horses in the deserts of Africa and Arabia; and he assures us, that he saw, in the solitudes of Numidia, a colt with crisped hair and a crisped mane. Marmol confirms this fact, by informing us, that small wild horses, some of them of an ash-colour, and others white, with short curled hair and manes, are to be found in the Lybian and Arabian deserts: he adds, that they out-run the dogs and domestic horses. We likewise learn from the Lettres Edifiantes that there are small wild horses in China.

But as Europe is now almost equally peopled, wild horses are no where to be found in this quarter of the globe. Those in America are the offspring of domestic horses, transported originally from Europe by the Spaniards. In these uninhabited, or rather depopulated regions, horses have multiplied prodigiously. That this species of animal was unknown in the New World, appears from the terror and astonishment expressed by the Mexicans and Peruvians at the sight of horses and their riders. The Spaniards carried great numbers of horses to these regions, both with a view to their service, and to the propagation of the breed. Many accordingly were left on the islands, as well as on the Continent, where they have multiplied like other wild animals. M. de Salle, in the year 1685, saw near the bay of St. Louis in North America, these horses grazing in the meadows; and they were so wild that he could not approach them. The author of the History of the Buccaneers remarks, 'That troops of horses, to the number of 500, are some-'times seen in the island of St. Domingo, who all run 'together; that when they perceive a man they all stop; 'and that one of them approaches to a certain distance, 'blows through his nostrils, takes flight, and is instantly 'followed by the whole troop.' He adds, that he is uncertain whether these horses have degenerated by becoming wild; but that he found none of them so handsome as those of Spain, though they sprung from the same race. 'They have,' he continues, 'very gross 'heads and limbs, and long necks and ears. The inha-'bitants tame them with ease, and then train them to 'labour. In taking them, gins of ropes are laid in the 'places where they frequent. When caught by the 'neck, they soon strangle themselves, unless some per-'son arrives to disentangle them. They are tied to 'trees by the body and limbs, where they are left for 'two days without victuals or drink. This trial is gene-'rally sufficient for rendering them more tractable, and 'they soon become as gentle as if they had never been 'wild; and even if they should by accident regain their 'liberty, they never resume their savage state, but know 'their masters, and allow themselves to be approached, 'and retaken with ease.'

These facts prove horses to be naturally of gentle dispositions, and much disposed to associate with man. They never forsake the abodes of men, to regain their liberty in the forests. They discover on the contrary great anxiety to return to the stable, where they find only coarse food, which is always the same, and often measured to them more by the rules of œconomy, than by the strength of their appetite. But the sweets of habit

supply all they have lost by slavery. After being oppressed with fatigue, the place of repose is full of delight. They smell it at a distance, can distinguish it in the midst of great cities, and seem uniformly to prefer bondage to liberty. They form a second nature out of those habits to which they have been forced to submit; for horses, after being abandoned in the forests, have been known to neigh continually, in order to be heard, to run to the voice of man, and even to grow meagre, and die in a short time, though surrounded with a profusion of nourishment.

Thus it is obvious the manners of a horse originate entirely from his education, which is accomplished by a care and industry bestowed by man upon no other animal; but he is amply rewarded by the perpetual services of this noble and laborious creature.

The foals are separated from their mothers at the age of five, six, or at most seven months; for experience shows that when allowed to suck ten or eleven months, though generally fatter and larger, they are not of equal value as those which have been more early weaned. After six or seven months, the foals are removed from their mothers, and are fed twice a-day with bran and a little hay, the quantity of which is augmented in proportion as they advance in age. They are confined to the stables as long as they discover any anxiety to return to their mothers. But when this inquietude is gone, they are allowed to go out, and are conducted to the pasture: they must not, however, be permitted to graze when their stomach is empty. An hour before being put to the grass, they should have a little bran, be made to drink, and should never be exposed to great colds or to rain. In this manner they pass the first winter. In the month of May following, they may be allowed to pasture freely every day, and to remain out continually till the end of October, observing only not to permit them to eat the aftermaths. If accustomed to feed upon this delicate herbage they will reject hay, which ought nevertheless, together with bran, to be their principal food during the second winter. They are managed in the same manner, namely, allowing them to pasture in winter during the day, and in summer during both day and night, till they arrive at the age of four years, when they are confined to dry food. This change of nourishment requires some precautions. During the first eight days, they should have only straw; and a few vermifuge draughts may be given to destroy those worms which may have been engendered by the bad digestion of crude herbs. M. de Garsault recommends this practice, the utility of which he had often experienced. It is however an established fact, that the stomachs of horses at all ages, and in all circumstances, whether they feed upon grass, or upon oats and hay, are perpetually stuffed with a prodigious multitude of worms. The stomach of the ass is always in the same condition; and yet none of these animals are incommoded by this species of vermin. These worms therefore ought not to be regarded as an accidental malady, occasioned by the indigestion of crude herbs, but rather as an effect depending on the common food and ordinary digestion of the horse and ass.

After young colts are weaned, they should not be put into too warm a stable, otherwise they will be rendered too delicate and too sensible to the impressions of the air. They should be often supplied with fresh litter, and kept clean by frequent friction. But they ought neither to be tied nor handled till they are near three years of age. The manger and rack should not be too high; for the necessity of stretching their neck and raising their head, may induce a habit of keeping them in that position, which would spoil their neck. When 12 or 18 months old their tails should be cut; the hair will shoot afterwards, and become stronger and thicker. At the age of two years, the male colts should be put with the horses, and the females with the mares. Without this precaution, the young males would fatigue and enervate themselves.

At the age of three years, or three and a half, we should begin to dress the colts, and to render them tractable. At first a light easy saddle should be placed on them, and allowed to remain two or three hours each day. They should likewise be accustomed to receive a snaffle into their mouths, and to allow their feet to be lifted and struck in imitation of shoeing. If destined for the coach or the draught, they ought to be harnessed as well as snaffled. A bridle is unnecessary at first: by means of a halter or cavesson on their nose, they may be made to trot up and down on a smooth piece of ground, with only a saddle and harness on their bodies: and when they turn easily, and approach without fear the man who holds the longe or halter, they may then be mounted and dismounted, without making them walk, till they be four years old; for before this period a horse has not strength enough to walk with a rider on his back. But at four years they may be mounted, and walked or trotted at small intervals. When a coach-horse is accustomed to the harness, he may be yoked with a bred horse, and guided with a longe or halter passed through the bridle, till he begins to know his duty. The coachman may next try to make him draw, with the assistance of a man to push him gently behind, and even to give him some slight lashes. All this education should be gone through, before the young horses have their diet changed; for after being fed with grain or straw, they are more vigorous, and consequently less docile, and more difficult to break.

The bit and the spur have been contrived to command the obedience of horses; the bit for the direction, and the spur for the quickness of their movements. Nature seems to have destined the mouth solely for receiving

the impressions of taste and of appetite. But the mouth of the horse is endowed with such amazing sensibility, that to this organ, in place of the eye and ear, man applies for conveying the indications of his will to this animal. The slightest motion or pressure of the bit gives him notice, and determines his course. This organ of sensation has no fault but that of perfection; its too great sensibility requires the most dexterous management; for the smallest abuse spoils the mouth, by rendering it insensible to the impressions of the bit. The senses of seeing and hearing cannot be blunted in this manner: but it is probable that all attempts to govern horses by these organs have been found inconvenient. Besides the signs transmitted by the touch have a stronger effect upon animals in general, than those conveyed by the eye or ear. The situation of a horse's eyes, with regard to his rider or conductor, is extremely unfavourable: and though they be often animated and conducted by the ear, it appears that the use of this organ is abandoned to the coarser species of horses; for in the menage they are seldom addressed by the ear. In a word, when horses are well educated, the smallest pressure of the thighs, the slightest movement of the bit, are sufficient to direct them. Even the spur is almost useless, being seldom employed but to force them to exert violent motions: and when from the ignorance of the horseman, he gives the spur, and at the same time retracts the bridle, the horse finding, himself incited on one side and restrained on the other, is obliged to rear, or make a perpendicular bound.

By means of the bridle the horse is taught to keep his head in the most beautiful and advantageous situation, and the smallest sign or slightest movement of the rider is sufficient to make the animal assume its different paces. The trot is perhaps the most natural motion of a horse; but the pace, and even the gallop, are most easy to the rider; and these are the two motions which are most in request. When a horse lifts his foreleg in order to walk, this movement must be made with steadiness and facility, and the knee must likewise be bended. The lifted leg must appear for a moment to be supported, and when let down, it must be firm, and equally supported on the ground, before the head receive any impression from this movement; for when the leg falls suddenly down, and the head sinks at the same time, this motion is generally made to give a speedy relief to the other leg, which is not strong enough alone to support the whole weight of the body. This is a very great defect in a horse. It is also worthy of remark, that when he rests on his heels, it is a sign of weakness; and when he supports himself on his toes, it is an unnatural and fatiguing attitude, which the horse cannot long continue.

Walking, though the slowest of all motions, ought to be brisk, light, and neither too long nor too short. Lightness depends much on the freedom of the shoulders, and is distinguished by the manner in which the horse, in walking, carries his head. If he carries his head high and steady, he is generally vigorous and light. When the movement of the shoulders is not sufficiently free, the limbs are not lifted high enough, and the horse is apt to stumble upon the road. In walking, a horse should raise his shoulders, and lower his haunches. He should also elevate and support his leg; but if he supports it too long, and allows it to fall down slowly, he loses every advantage of lightness; his walk becomes hard, and he is good for nothing but state and parade.

But lightness is not the only good quality in the movements of the horse: they should likewise be equal and uniform both before and behind: for if the crupper vibrates when the shoulders are supported, his motion will be jolting and incommodious to the rider. The same thing happens when the horse lengthens so much the step of the hind-leg, that the foot lights beyond the print of the fore-foot. Horses with short bodies are subject to this fault. Those whose legs cross each other, or hew, have an unsteady motion; and in general, long-bodied horses are most commodious to the rider, because he is placed at a greater distance from the two centres of motion, the shoulders and haunches, and is of course less jolted.

The general mode of walking among quadrupeds is to lift at one time, a fore-leg and a hind-leg of opposite sides. As their bodies rest on four points which form an oblong square, the most commodious manner of moving is to change two at a time in the diagonal: so that the centre of gravity of the animal's body may always remain nearly in the direction of the two points of support which are not in motion. In the three natural movements of the horse, namely, the walk, the trot, and the gallop, this mode is always observed, though with some variations. In walking there are four beats or times of moving; if the right fore-leg moves first, the left hind-leg instantly follows; then the left fore-leg moves, and is instantly followed by the right hind-leg. Thus the right fore-foot rests first on the ground, then the left hind-foot, next the left fore-foot, and lastly, the right hind-foot, which makes a motion consisting of four beats and three intervals, of which the first and third are shorter than the middle one. In the trot there are only two beats: if the right fore-leg parts from the ground, it is accompanied at the same time by the left hind-leg; then the left fore-leg moves at the same time with the right hind-leg; so that in this motion there are but two beats and one interval; the right fore-leg and the left hind-leg rests on the ground at the same time, and the same thing happens with regard to the left fore-leg and the right hind-leg. In the

gallop there are commonly three beats: the left hind-leg moves first and rests first on the ground; then the right hind-leg is raised along with the left fore-leg, and both rest on the ground at the same time; and lastly, the right fore-leg is raised instantly after the left fore-leg and the right hind-leg, and falls last upon the ground. Thus in the gallop there are three beats and two intervals: in the first interval, when the motion is quick, the four legs for an instant are in the air at the same time, and the four shoes appear at once. When the horse has supple limbs and haunches, and moves with agility, the gallop is most perfect, and the feet fall at four times, first the left hind-leg, then the right hind-leg, next the left fore-leg, and lastly, the right fore-leg.

Horses generally gallop upon the right foot, in the same manner as they set out in walking or trotting, with the right fore-leg. In galloping they first cut the road with the right fore-leg, which is farther advanced than the left; and the right hind-leg which immediately follows the right fore-leg, is likewise farther advanced than the left hind-leg. Hence the left leg, which bears the whole weight, and pushes the others forward, has the greatest fatigue; so that it would be proper to learn horses to gallop alternately upon the left and right legs; because it would enable them to continue this violent motion much longer. This is practised at the menage, but perhaps for no other reason, but because in galloping round a circle, the centre of which is sometimes on the right, and sometimes on the left, the rider is frequently obliged to change his hand.

In walking, the horse raises his feet very little above the surface; in trotting, he elevates them a little more, and in galloping, still higher. The walk ought to be smart, light, and sure; the trot should be firm, quick, and equally supported, and the fore-legs pushed with rapidity by the hind ones. The trotting horse should carry his head pretty high, and keep his body straight; nor if the haunches rise and fall alternately at every movement, and if the crupper rocks, the animal is too weak for this motion. To throw the fore-legs out is another fault: they ought always to be on the same line with those behind, and to efface their prints. When one of the hind-legs moves, and if the fore-leg on the same side rests too long, the movement becomes hard by this resistance. It is for this reason that the interval between the two beats of the trot ought to be short: but however short it may be, this resistance is sufficient to make the trot harder than the walk or gallop.

The spring of the hocks contributes as much to the motions of galloping as that of the loins. While the latter make an effort to elevate and push forward the anterior parts, the spring of the hocks breaks the stroke and softens the shock. Hence the more uniform and strong the spring of the hocks, the gallop is softer and more rapid.

Though walking, trotting, and galloping, be the natural and ordinary movements of horses, yet some of them have another natural motion, known by the name of ambling, or pacing, which is very different from the other three; and though less quick than the hard trot or gallop, it appears at first sight to be extremely fatiguing to the animal. The foot of the horse in this movement, grazes the surface still nearer than in walking, and each step is much longer. But what is singular, to make a pace the two legs of the same side part from the ground at the same time, the fore and hind-leg, for example, of the right side, and then the two legs of the left side; so that each side of the body alternately want support, which must greatly fatigue the animal, who is obliged to support a balance forced by the rapidity of a movement which is hardly elevated above the ground; for nothing but the rapidity of the motion, and the smallness of the elevation, could possibly prevent the creature from falling on his side. In the motion of pacing, as in that of trotting, there are only two beats. This movement, which is very laborious to the horse, and in which he ought not to be indulged except on smooth ground, is very easy to the rider; it has not the hardness of the trot, because the hind-leg moves along with the fore one, and creates no resistance to the motion. We are told by connoisseurs, that horses which naturally amble, never trot, and that they are much weaker than those which have no such movement. Colts indeed often assume this mode of moving, when forced to go quick, and when they have not strength enough to trot or to gallop; and even good horses, after being fatigued, or when they begin to decay, are apt when pushed to amble spontaneously.

The amble may be therefore regarded as a motion occasioned by weakness or defect. But there are two other movements assumed spontaneously by weak or decayed horses, which are still more defective than that of the amble, and are known by the name of broken ambles. The one is a motion between walking and ambling, and the other between trotting and galloping. Both proceed from great fatigue, or weakness in the loins, and are conspicuous in many of our hackney and post-horses.

Of all quadrupeds, the horse possesses, along with grandeur of stature, the greatest elegance and proportion of parts. By comparing him with the animals immediately above or below him, we find that the ass is ill made; that the head of the lion is too large; that the limbs of the ox are too slender and too short, in proportion to the size of his body; that the camel is deformed; and that the grosser animals, as the rhinoceros and elephant, may be considered as rude and shapeless masses. The great difference between the head of man and that of the quadrupeds consists in the length of their jaws, which is the most ignoble of all characters. But though the jaws of the horse be very long, he has

not, like the ass, an air of imbecility, nor like the ox, of stupidity. The regularity and proportion of the parts of his head give him a light and sprightly aspect, which is well supported by the beauty of his chest. He elevates his head, as if anxious to exalt himself above the condition of quadrupeds. In this noble attitude he regards man face to face. His eyes are open and lively, his ears handsome and of a proper height, being neither too long, like those of the ass, nor too short, like those of the bull. His mane adorns his neck, and gives him the appearance of strength and of courage. His long bushy tail covers and terminates with advantage the extremity of his body. His tail, very different from the short tails of the deer, elephant, &c. and from the naked tails of the ass, camel, rhinoceros, &c. is formed of long thick hairs which seem to arise from his crupper, because the trunk from which they proceed is very short. He cannot, like the lion, elevate his tail, but though pendulous, it becomes him better: and as he can move it from side to side, it serves him to drive off the flies which incommode him; for though his skin be very firm, and well garnished with close hair, it is extremely sensible.

The attitude of the head and neck contributes more than all the other parts of his body to give him a graceful aspect. The superior part of the neck, from which the mane issues, should first rise in a straight line from the withers, and then, as it approaches the head, form a curve nearly similar to that of a swan's neck. The inferior part of the neck should have no curvature, but rise in a straight line from the poitrel, or breast, to the under jaw, with a small inclination forward. If it rose in a perpendicular direction, its symmetry and gracefulness would be diminished. The superior part of the neck should be thin, with little flesh near the mane, which ought to be garnished with long delicate hair. A fine neck should be long and elevated, but proportioned to the general size of the animal. When too long the horse commonly throws back his head; and when too short and fleshy, the head is heavy to the hand. The most advantageous position of the head is, when the front is perpendicular to the horizon.

The head of a horse should be thin and meagre, and not too long. The ears should be small, erect, but not too stiff, narrow, and placed on the upper part of the head, at a proper distance from each other. The front should be narrow and a little convex, the eye-pits, or hollows between the eyes and ears, well filled, and the eye-lids thin; the eyes should be pretty large and prominent, clear, lively, and full of fire; the pupil should be rather large, the under jaw a little thick, but not fleshy, the nose somewhat arched, the nostrils open and deep, and divided by a thin septum or partition. The mouth should be delicate and moderately split, lips thin, withers sharp and elevated, the shoulders flat, and not confined; the back equal, a little arched lengthwise, and raised on each side of the back-bone, which ought to have the appearance of being sunk; the flanks should be short and full, the crupper round and plump, the haunches well furnished with muscular flesh, the dock or fleshy part of the tail firm and thick, the thighs large and fleshy, the hock round before, broad on the sides, and tendinous behind; the shank thin before, and broad on the sides; the tendon (or tendo Achillis) prominent, strong, and well detached from the leg-bone, and the fetlock somewhat prominent, and garnished with a small tuft of long hair behind; the pasterns should be of a middling length, and pretty large; the coronet a little elevated, the hoof black, solid, and shining, the instep high, the quarters round, the heels broad, and a little prominent, the frog thin and small, and the sole thick and concave.

Few horses possess all these perfections. The eyes are subject to many faults, which it is often difficult to distinguish. In a sound eye two or three soot-coloured spots appear through the cornea above the pupil; for unless the cornea be clean and transparent, these spots cannot be seen. When the pupil is small, long, and narrow, or surrounded with a white circle, or when it is of a greenish blue colour, the eye is unquestionably bad.

Without entering into a long detail, the following general remarks will enable the reader to form a judgment of the principal perfections and imperfections of a horse. The motion of the ears affords a tolerable criterion: when a horse walks, the point of his ears should incline forwards; when fatigued, his ears hang down; and when angry or of a malignant disposition, he points alternately one of his ears forwards and another backwards. Every horse turns his ears to that side from which he hears any noise; and when struck on the back or on the crupper, he turns his ears backward. Horses with hollow eyes, or with one eye smaller than the other, have generally a bad sight. Those whose mouths are dry have not such good constitutions as those that have moist mouths, and foam with the bit. The shoulders of a saddle horse should be flat, supple, and not too fleshy. A draught horse, on the contrary, ought to have thick, round, fleshy shoulders. If however the shoulders of a saddle horse be too meagre, and the bones advance too much through the skin, it is an indication that his shoulders are not free, and that of course he will be unable to undergo much fatigue. Another defect of a saddle-horse is to have the poitrel, or breast, too prominent, and the fore-legs inclined or placed too far backward; because in this case he is subject to lean heavy upon the hand in galloping, and even to stumble and fall. The length of the legs should be proportioned to the stature of the horse. When the fore-legs are too long, he is not steady on his feet; and when too short, he bears heavy on the hand. It has been remarked that mares are more liable than horses to be low before, and

that stone-horses have thicker necks than mares or geldings.

It is of great importance to know the age of a horse. The eye-pits of old horses are commonly hollow: but this mark is equivocal; for young horses begot by old stallions have likewise hollow eye-pits. The teeth afford the best criterion of the age of horses. The horse has in all 40 teeth, viz. 24 grinders, 4 canine or tushes, and 12 fore-teeth. Mares have either no dog-teeth, or very short ones. The canine and fore-teeth only afford indications of the age. Five days after birth the fore-teeth begin to shoot. These first teeth are round, short, and not very solid; and they fall out at different times to be replaced by others. At two years and a half the four middle fore-teeth fall out, two above and two below. The next year other four are shed, one on each side of the first, which are now replaced. At four years and a half, other four fall out, always on each side of those which were formerly shed and replaced. These last four foal-teeth are succeeded by other four, which grow not near so quickly as the first eight. It is from these four, called corner-teeth, that the age of a horse is distinguished; and they are easily known, being always the third, both above and below, reckoning from the middle to the extremity of the jaw. They are hollow, and have a black mark in their cavities. At four and a half, or five years, these teeth hardly rise above the gums, and their cavities are very perceptible. At six years and a half, the cavities begin to fill up, and the mark gradually diminishes till the animal is seven and a half, or eight years, when the cavities are perfectly filled, and the mark totally effaced. After this period, the age is attempted to be discovered by the tushes or canine teeth. These four teeth lie immediately adjacent to the other four above described. Neither the tushes nor grinders shed. At the age of three years and a half the two tushes of the under jaw generally begin to shoot; the two of the upper jaw appear at the age of four, and till six years be completed they are very sharp. At ten years the tushes of the upper jaw seem to be blunted, worn out, and long, because the gums retract with age; and the more this appearance takes place, the older is the horse. From ten to thirteen or fourteen years, there are hardly any marks by which the age may be discovered. Some hairs of the eye-brows indeed begin to grow white; but this mark is equally equivocal as that derived from the depth of the eye-pits; for it has been remarked, that horses begot by old stallions and old mares, have white hairs in the eye-brows at the age of nine or ten. The teeth of some horses are so hard that they wear not by eating, and never lose the black mark. But these horses are easily known, because the cavities of their teeth are perfectly filled up, and their tushes are very long. The age of a horse may likewise be known, though with less precision, by the bars or ridges of the palate, which are effaced in proportion as he advances in years.

At the age of two years, or two and a half, the horse is in a condition to propagate; and the mares, like most other females, are still sooner ripe for this operation. But the foals produced from such early embraces are weakly, or ill-formed. The horse should never be admitted to the mare till he is four or four and a half; and even this period is too early, except for coarse or draught-horses. When fine horses are wanted, the male should be not admitted to the mare before he is six years old; and Spanish stallions not till they be full seven. The mares may be one year younger: they generally come in season from the end of March to the end of June. But their chief ardour for the horse lasts not above 15 days, or three weeks; and during this critical period the mare should be admitted to the stallion: he ought to be sound, vigorous, well made, and of a good breed. To procure fine saddle-horses, foreign stallions, as Arabians, Turks, Barbs, and Andalousians, are preferable to all others. Next to these, British stallions are the best; because they originally sprung from those above-mentioned, and are very little degenerated. Italian stallions, especially those of Naples, are extremely good. With mares of a proper size they produce excellent horses for the saddle; and with strong large mares they produce good coach horses. It is alledged, that in France, Britain, &c. the Arabian and Barbary stallions generally beget horses larger than themselves; and that those of Spain, on the contrary, produce a breed more diminutive. The best stallions for coach-horses are those of Naples, Denmark, Holstein, and Friesland. The stallions for saddle-horses should be four feet eight or ten inches, and five feet at least for coach-horses. Neither ought the colour of stallions to be overlooked, as a fine black, grey, bay, sorrel, &c. All party-coloured, or ill-defined colours, ought to be banished from the stud, as well as every horse which has white extremities. Besides these external qualities, a stallion should be endowed with courage, tractability, and spirit; he should have agility, a sensible mouth, and sure limbs; his shoulders should be perfectly free, and his haunches supple; he should have a spring and elasticity in his whole body, especially in his hind legs; and he ought to be trained and dressed in the riding-school. These precautions in the choice of a stallion are the more necessary, because it has been found by experience, that he communicates to his offspring almost all his good or bad qualities, whether natural or acquired. A horse naturally cross, skittish, restive, &c. produces foals of the same dispositions: and as the defects of conformation and the vices of the humours are more certainly perpetuated than the qualities of the temper, one should reject from the stud every horse that is deformed or diseased, extremely vicious, glandered, broken-winded, frantic, &c.

In our climate the mare contributes less to the beauty of her offspring than the stallion; but she contributes more, perhaps, to their stature and constitution. It is therefore of great importance that mares for breed should be sound, tall, large, roomy in the trunk of the body, and good nurses. For elegant horses, Spanish and Italian mares are best; but for draught-horses, those of Britain and Normandy are preferable. However, when the stallions are good, fine horses may be produced from mares of any country, provided they be well made and of a good breed: for if the mares have sprung from a bad stallion, their offspring are generally defective. In horses, as in the human species, the young very frequently resemble either their male or female predecessors; only it should appear, that among the horse-kind, the female contributes less to the work of generation than in the human species. The son more frequently resembles his mother than the foal does the mare from which he is produced; and when the foal happens to resemble his mother, the likeness is generally confined to the anterior parts of the body, as the head and neck.

To judge of the resemblance of children to their parents, the comparison ought not to be made till after the age of puberty. For at this period so many changes take place, that a person with whom we were formerly familiar, we will hardly at first sight be able to distinguish. In the human species, the son after puberty often resembles the father, and the daughter the mother, and not unfrequently each retains a partial likeness to both parents; and this family likeness is generally recognisable in uncles, aunts, and in every ascending or descending branch. Among horses, as the male contributes more to the offspring than the female, mares very frequently produce foals which have a great resemblance to the stallion, or which always resemble the father more than the mother. And even when the mare has been begot by a bad horse, it often happens, that though served by a good stallion, and though handsome herself, her offspring though beautiful and well made at first, gradually decline as they grow up; and other mares, sprung from a good race, produce foals, which though they have an unpromising aspect when young, improve as they advance in years.

These facts, though they seem to concur in proving that the males have greater influence on the offspring than the females, appear not to be sufficient to render this point altogether unquestionable. It is by no means surprising, that stallions which are always selected from a great number, generally imported from a warm climate, and fed and managed with the greatest care and circumspection, should prevail in the business of generation, over common mares, bred in a cold country, and often subjected to hard labour. If mares were selected from warm climates, managed with equal attention, and served with the common stallions of our own country, I have not the smallest doubt, that in this case the superiority of the females would be equally apparent as that of the males; and in general, that among horses, as well as the human species, the influence of both parents, when placed in equal circumstances, is nearly the same. What renders this opinion both more natural and more probable, is the well known fact, that in studs, the number of females produced is equal to that of the males; which is a clear proof that with regard to sex at least, the female contributes her full proportion.

But to return to our subject. When the stallion is chosen, and the mares are assembled, another stonehorse should be allowed to teaze them, for no other purpose but to discover those which are in season. Those that are not in proper condition repel his attacks. But instead of allowing him to proceed with the mares which are in season, he is led off, and the true stallion is substituted in his place. This trial is chiefly useful for discovering the condition of such mares as have never produced; for those which have produced are commonly in season nine days after their delivery, and may be safely covered on the tenth day. Nine days after, their condition may be tried by the above proof, and if still in season, they should be covered a second time, and so on every ninth day, till their ardour abates, which happens a few days after conception. But to conduct this matter properly, requires considerable attention and expence. The stud should be established on good ground, and its dimensions proportioned to the quantity of mares and stallions employed. This ground should be divided into several apartments, and well fenced with ditches or hedges. The impregnated mares, and those which are suckling their young, should have the richest pasture. Another enclosure where the grass is less rich, should contain the uncovered mares, those that have not conceived, and the female foals; for a rich pasture makes them grow too fat, and weakens the generative faculty. Lastly, the young male foals and geldings should be confined to the driest and most unequal part of the ground, that by ascending and descending the eminences, they may acquire a freedom in their limbs and shoulders. This last enclosure should be well fenced from that which contains the mares, to prevent the young horses from enervating themselves by premature efforts. If the field be sufficiently extensive, each of these enclosures should be divided into two, and grazed alternately by horses and oxen. This mode of grazing improves the pasture; for the ox repairs what is injured by the horse. Each park should likewise be furnished with a pond, which is better than a running water, and also with trees to shelter the animals from too much heat; but to prevent accidents, all old stumps should be rooted out, and deep holes filled up. These pastures will afford sufficient nourishment to the stud during the summer; but in winter, the mares and foals should

be put into stables, and fed with hay, except in very fine weather, when they may be set out to pasture during the day. The stallions should be always kept in the stables, fed with a greater proportion of straw than of hay, and moderately exercised till the time of covering, which generally lasts from the beginning of April till the end of June. During this period, they should be fed plentifully, but with no other article than their ordinary food.

When the stallion is conducted to the mare, to augment his ardour he should be well dressed. The mare should have the shoes taken off her hind-feet; for some of them are apt to kick at the approach of the stallion. One man holds the mare by the head, and two others lead the stallion by long reins. When in a proper situation he should be assisted by the hand, by turning aside the tail of the mare; for the opposition of a single hair might wound him in a dangerous manner. The stallion sometimes quits the mare without consummating. If the trunk of his tail near the crupper vibrates before he descends, we may be certain that he has consummated; for this motion always accompanies emission. After consummation, the act should not be reiterated; but he ought to be carried back immediately to the stable, there to remain two days: for though a horse might be able to cover every day during the season, yet if only admitted once in two days, he is both more vigorous and more successful. During the first seven days therefore let him have four different mares, and on the ninth, let him again cover the first mare, and so on as long as they continue in season. When one of the mares ceases to be ardent, another should be substituted in her place; and as many are impregnated at the first, second, or third time, a stallion managed in this manner may cover 15 or 18 mares, and produce 10 or 12 foals, during the three months that these amours continue. Stallions throw out a vast profusion of seminal fluid; mares likewise emit, or rather distil, a fluid during the time they are in season: and as soon as they are pregnant, these emissions cease. This fluid was called hippomanes by the Greeks; and of it they are said to have made love-potions, which rendered horses in particular, frantic with desire. The hippomanes is totally different from the fluid found in the membranes that cover the foal, which was first discovered and described by M. Daubenton. The appearance of the hippomanes is the most certain mark of ardour in mares. This passion may likewise be discovered by the swelling of the under part of the vulva, and by the frequent neighing of the mares, who at this period have a strong desire of approaching the horse. After a mare has been covered, she may be led to the pasture without any other precaution. The first foal is always more puny than the subsequent ones: to compensate this defect, a mare should be served for the first time, with a large stallion. The differences in the figures of the horse and mare should be attended to, in order to correct the faults of the one by the perfections of the other; and no disproportioned conjunctions ought to be admitted, as of a small horse and a large mare, or of a large horse and a small mare; for the produce of such conjunctions will either be small or ill-proportioned. In order to improve Nature, we must advance by gradual steps: a plump but handsome horse, for example, may be admitted to a mare that is too gross, a small mare to a horse a little taller, a mare with a bad fore-hand to a horse with a fine head, neck, &c.

It has been remarked, that studs kept in dry light soils produce active, nimble, and vigorous horses, with nervous limbs and strong hoofs; while those kept in moist ground, and in too rich pasturage, have generally large heavy heads, gross bodies, thick legs, bad hoofs, and broad feet. It is easy to perceive that these differences proceed from the varieties in climate and food. But the necessity of crossing the breed to prevent the degeneration of horses, is more difficult to understand, and of more importance to be known.

There is in Nature a general prototype of every species, upon which each individual is modelled, but which seems in its actual production, to be depraved or improved by circumstances; so that with regard to certain qualities, there appears to be an unaccountable variation in the succession of individuals, and at the same time an admirable uniformity in the entire species. The first animal, the first horse, for example, has been the external and internal model, upon which all the horses that have existed, or shall exist, have been formed. But this model, of which we know only copies, has had, in communicating and multiplying its form, the power of adulterating or of improving itself. The original impression is preserved in each individual. But among millions of individuals, not one exactly resembles another, nor of course, the model from which they sprung. This difference, which shows that Nature is not absolute, but knows how to vary her works by infinite shades, is equally conspicuous in the human species, in all animals, and in all vegetables. What is singular, this model of the beautiful and the excellent, seems to be dispersed over every region of the earth, a portion of which resides in all climates, and always degenerates, unless united with another portion brought from a distance. In order therefore to obtain good grain, beautiful flowers, &c. the seeds must be changed, and never sown in the same soil that produced them. In the same manner, to have fine horses, dogs, &c. the males and females of different countries must have reciprocal intercourse. Without this precaution, all grain, flowers, and animals degenerate, or rather receive an impression from the climate so strong as to deform and adulterate the species. This impression remains, but it is disfigured by every feature

that is not essential. By mixing races, on the contrary, or by crossing the breed of different climates, beauty of form, and every other useful quality, are brought to perfection: Nature recovers her spring, and exhibits her best productions.

I mean not to enter into a detail of the causes of these effects; but shall confine myself to such conjectures as most readily present themselves. We know by experience, that animals or vegetables, transported from distant climates, often degenerate, and sometimes come to perfection, in a few generations. This effect, it is obvious, is produced by difference of climate and of food. The operation of these two causes must, in process of time, render such animals exempt from, or susceptible of certain affections, or certain diseases. Their temperament must suffer a gradual change. Of course their form, which partly depends on food and the qualities of the humours, must also in the course of generations suffer an alteration. This change, it is true, is hardly perceptible in the first generation; because the male and female, which we supposed to be the origin of this race, being fully grown, had received their form and structure before they were transported. The new climate and new food may change their temperament; but cannot have influence upon the solid and organic parts sufficient to alter their form. The first generation of these animals therefore will not suffer any change in their figure; nor at the instant of birth will the stock be vitiated or depraved. But the young and tender stranger will feel a much stronger impression from the climate than its father or mother experienced. The operation of food will likewise be so great as to influence the organic parts during the time of the animal's growth: a change will of course be introduced into its form; the seeds of imperfection will be sown, and appear, in a sensible manner, in the second generation, which will not only labour under its own proper defects, or those proceeding from its growth and nourishment, but inherit all the vices of the second stock. Lastly, the imperfections and deformities transmitted to the third generation, being combined with the influence of the climate and food during the growth of the animal, will become so great as to obliterate entirely the characters of the original stock. Hence in a few generations, animals transported into a climate different from their own, lose all their distinctive qualities, and acquire those peculiar to the country they are obliged to inhabit. In France, Spanish or Barbary horses, when the breed is not crossed, become French horses sometimes in the second generation, and always in the third. Instead of preserving the breed distinct therefore, it is necessary to cross it every generation, by admitting Spanish or Barbary horses to the mares of the country. It is singular that this renewing of the race, which is only partial, produces better effects than if it were complete. A Spanish horse and mare will not produce such fine horses in France, as those bred from a Spanish horse and a French mare. This may easily be conceived if we attend to the compensation of defects which necessarily happens when males and females of different countries are allowed to intermix. Every climate, by its influence joined to that of the food, gives a certain conformation of parts, which errs either by excess or defect. When a warm climate produces redundancies in particular parts, a cold climate gives rise to deficiencies in the same parts: hence when animals of opposite climates intermix, an exact compensation is effected. As the most perfect work of nature is that in which there are fewest defects, and as the most perfect forms are those which have fewest deformities, the production of two animals whose faults exactly compensate each other will be the most perfect of the kind. Now this compensation being always completest when animals of remote, or rather of opposite climates, are joined, the compound resulting from the mixture is more or less perfect, in proportion as the excess or defects in the constitution of the father are opposed to those peculiar to the mother.

To have good horses therefore in the temperate climate of France, stallions should be brought from the warmest or the coldest countries. The Arabian or Barbary horses ought to have the preference; and after them those of Spain and of Naples. With regard to cold climates, the horses of Denmark should be preferred, and next to them those of Holstein and Friesland. All these stallions, when admitted to French mares, will produce very fine horses; and they will always be better and more beautiful, in proportion as the climate is more remote from that of France; so that the Arabian horse is preferable to the Barb, and the Barb to the Spanish. In the same manner, stallions brought from Denmark will produce finer horses than those brought from Friesland. When stallions from very warm or very cold countries cannot be procured, they should be brought from England or Germany, or even from the southern provinces of France to the northern. Some advantage is always obtained by serving mares with strange horses; for when those of the same race, and in the same stud, are allowed to intermix, they infallibly degenerate in a very short time.

The influence of climate and of food upon the human species is not so great as upon other animals. The reason is obvious. Man defends himself better than any other animal from the intemperance of the climate. He accommodates his lodging and clothes to the nature of the season. His food is more various, and consequently does not operate in the same manner upon every individual. The defects or redundancies which proceed from these two causes, and which are so constant and so perceptible in the animals, are by no means equally conspi-

cuous in man. As migrations have often happened, as whole nations have intermixed, and as many men travel and disperse themselves through every quarter of the globe, it is not surprising that the human race are less subject to the influence of climate, and that strong, handsome, and even ingenious men are to be found in every country. It is probable, however, that from an experience, of which all remembrance is now lost, men had discovered the evils that result from alliances of the same blood; for even among the most unpolished nations a brother has rarely been permitted to marry his sister. This custom, which among Christians is a divine law, and which is observed by other people from political motives, may have originally been founded on observation. Policy, unless when derived from physical considerations, never extends in a manner so general and so absolute. But if men once discovered by experience that their race degenerated, when intercourse was permitted among children of the same family, they would soon regard the alliances of different families as a law established by nature. In a word, we may presume from analogy, that in most climates, men, like other animals, would degenerate after a certain number of generations.

The variety in the colour of animals is another effect to be ascribed to the influence of climate and food. Wild animals which live in the same climate, are of the same colour, varying only in brightness or deepness, according to the seasons of the year. Those, on the contrary, which live under different climates, differ likewise in colour; and domestic animals are so prodigiously varied, that we have horses, dogs, cats, &c. of every kind of colour. But the stag, the hare, &c. are uniformly of the same colour. The injuries received from the climate, which are always the same, and the constant eating of the same food, produce this uniformity in the wild animals. The care of man, the luxury of shelter, and the variety of nourishment, efface and variegate the original colours in domestic animals. The mixture of foreign races, especially when the males and females are not of the same colour, produce the same effect, and sometimes give rise to beautiful varieties, as the pied horses, in which the white and black are often disposed in a manner so fanciful, as to seem to be rather the operation of art than of nature.

In coupling horses, regard should be had to the stature and the colour: the figures should be contrasted, and the breed crossed by stallions from the most opposite climates. Horses and mares brought up in the same stud should never be allowed to intermix. These are essential requisites. But there are other circumstances which ought not to be neglected. For example, in a stud no mares with short tails should be kept: because being unable to defend themselves from the flies, they are perpetually tormented. The continual agitation occasioned by the stinging of these insects, diminishes the quantity of milk, which has so great an influence on the constitution and stature of the foal, that its vigour is always proportioned to the goodness of its nurse. Brood-mares should be chosen from those which have been always pastured, and never fatigued with labour. Mares which have been long nourished in a stable with dry food, and afterwards turned out to grass, conceive not at first. Time is necessary to accustom them to this new kind of nourishment.

The common season of mares is from the beginning of April to the end of June; but the ardour of some not unfrequently appears at a more early period. An ardour so premature should be repressed; because the foal would be brought forth in cold weather, and consequently suffer both from the intemperance of the season and from bad milk. If this ardour appears not till after the month of June, it should likewise be repressed; because the foal would be produced in summer, and would not acquire strength enough to resist the rigours of winter.

Instead of conducting the stallion to the mare, it is not uncommon to allow him to go loose in the parks where the mares are feeding, and to single out such as are in season. By this method the mares conceive more readily. But it injures the stallion more in six weeks than he would be by six years exercise, moderated and conducted in the manner above directed.

When the impregnated mares begin to grow heavy, they should be separated from those which are not in that condition, to prevent them from receiving any injury. Their period of gestation is generally eleven months and some days. They bring forth in a standing posture, while most other quadrupeds lie down. When the delivery is difficult, they require the assistance of man; and when the foal is dead, it is extracted with cords. As in most animals, the colt first presents its head. In escaping from the uterus it breaks the membranes, and the waters flow abundantly. The waters are accompanied with several solid masses, formed by the sediment of the liquor of the allantoiedes. Those masses, called hippomanes by the ancients, are not, as they supposed, pieces of flesh attached to the head of the foal. They are, on the contrary, separated from the foal by the amnios. Immediately after birth, the mare licks the foal: but she never touches the hippomanes, though the ancients assert that she instantly devours it.

It is usual to cover a mare nine days after she has foaled, that no time may be lost, and that every possible profit may be derived from the stud. It is certain, however, that her strength being divided, she is unable to nourish both a foal and a fœtus so successfully as if she had but one at a time. To procure excellent horses therefore, the mares should be covered but once in two years, which would make them live longer, and hold

more surely; for in ordinary studs, it is well if a half or two thirds bring forth in a year.

Mares, though impregnated, can suffer to be covered; and yet there are no instances of super fœtation. In general, they are capable of producing to the age of 14 or 15 years, and the most vigorous produce not after 18. Stallions when properly managed, retain their prolific powers to the age of 20 years, and sometimes longer: and as in man, those which begin too early are soonest extinguished; for the large horses, which come sooner to maturity than fine ones, and are employed as stallions at the age of four years, are commonly useless at 15.

The life of horses, as in every other species of animals, is proportioned to the time of their growth. Man, who grows 14 years, can live six or seven times as long, i. e. 90 or 100. The horse, whose growth is accomplished in four years, can live six or seven times as much, i. e. 25 or 30. The exceptions to this rule are so few, that no conclusions can be drawn from them: and as large horses come sooner to maturity than the delicate ones, their lives are likewise shorter, and they are superannuated in 15 years.

In horses and most other quadrupeds, the growth of the posterior parts seems at first to be greater than that of the anterior. But in man, the growth of the inferior parts is at first less than that of the superior: for the thighs and legs of infants are, in proportion to their bodies, much less than those of adults. The hind legs of the foal, on the contrary, are so long that they can reach his head, which is by no means the case after he acquires his full growth. But this difference proceeds not so much from the inequality in the total growth of the anterior and posterior parts, as from the unequal lengths of the fore and hind feet, which uniformly holds through all Nature, and is most remarkable in quadrupeds. Man's feet are larger, and likewise sooner formed than his hands. The greatest part of the horse's hind leg is only a foot, being composed of bones corresponding to the tarsus, metatarsus, &c. It is not therefore surprising, that this foot should be sooner expanded than the fore-leg, the inferior part of which represents the hand, being composed of the bones of the carpus, metacarpus, &c. This difference is easily perceived immediately after a foal is brought forth. The fore-legs, when compared with the hind ones, are proportionably much shorter than they are to be afterwards. Besides the thickness which the body acquires, though independent of the proportional growth in length, increases the distance between the hind-feet and the head, and consequently, prevents the animal when full grown, from reaching the head.

In all animals, each species varies according to the climate; and the general results of these varieties constitute different races. Of these we can only distinguish the most remarkable, or those that sensibly differ from each other, passing over the intermediate shades, which here, as in all the operations of Nature, are infinite. We have even augmented their number and confusion by cherishing the mixture of races. If the expression may be used, we have dealt roughly with Nature, by bringing into our climates the horses of Asia and of Africa. By introducing into France the horses of every country, the primitive race cannot now be recognized; so that to distinguish horses, there remains only a few slight characters produced by the actual influence of the climate. These characters would be still better marked, and the differences more sensible, if the races of each climate were preserved without mixture. These small varieties would be more apparent and less numerous; but there would be a certain number of great varieties, which every man could distinguish with ease. Instead of which, habit, and even long experience, are necessary to enable us to know the horses of different countries. On this subject we have no light but what is derived from the books of travellers, the works of Newcastle, Garsault, Gueriniere, &c. and some remarks communicated to us by M. de Pignerolles, master of horse to the King of France, and president of the academy of Angers.

The Arabian horses are the most beautiful. They are larger, more fleshy, and handsomer than the Barbs. But as they are seldom brought into France, few observations have been made with regard to their perfections or defects.

Barbary horses are more common. They have a long fine neck, not overcharged with hair, and well divided from the withers. The head is small and beautiful. The ears are handsome and properly placed, the shoulders are light and flat. The withers are thin and well raised. The back is straight and short. The flank and sides are round, and the belly not too large. The haunch-bones are properly concealed; the crupper is somewhat long, and the tail placed rather high. The thigh is well formed, and rarely flat. The limbs are fine, handsome, and not hairy. The tendon is prominent, and the foot well made; but the pastern is often long. They are of all colours, but generally grayish. In their movements they are apt to be careless, and require to be checked. They are swift, nervous, light, and make extremely fine hunters. These horses appear to be the most proper for improving the breed. Their stature however is not so large as could be wished. They are seldom above four feet eight inches, and never exceed four feet nine. It is confirmed by repeated experiments, that in France, England, &c. they produce foals which grow larger than their parents. Of the Barbary horses, those of the kingdom of Morocco are said to be the best, and next to these are the Barbs from

the mountains. The horses of Mauritania are of an inferior quality, as well as those of Turkey, Persia, and Armenia. All the horses of warm climates have smoother and shorter hair than those of other countries. The Turkish horses are not so well proportioned as the Barbs. Their necks are generally slender, their bodies long, and their legs too thin. They are however excellent travellers, and have a long wind. It will not be thought surprising, that the bones of animals are harder in warm than in cold climates. It is for this reason that, though they have thinner shank bones than the horses of this country, their limbs are stronger.

The Spanish horses, which hold the second rank after the Barbs, have a long, thick, hairy neck. The head is rather gross and fleshy. The ears are long, but well situated. The eyes are full of fire, and their air is bold and noble. The shoulders are thick and the chest broad. The reins are often a little low, the sides round, and the belly frequently too big. The crupper is generally round and large, though in some it is rather long. The limbs are fine and not hairy; the tendons of the legs are prominent; the pastern is sometimes too long, like that of the Barb; the foot is rather long, like that of the mule; and the heel is often too high. The Spanish horses of the best race are thick, plump, and of a low stature. Their movements are likewise quick and supple; and they are remarkable for spirit and boldness. Their colour is commonly black, or a dark chesnut, though they are to be found of all colours. Their noses and limbs are seldom white. These marks are disliked by the Spaniards, who never breed from those which have such characters. Their favourite mark is a star in the forehead; and they esteem a horse without a single spot, as much as we despise him. Both of these prejudices, though opposite to each other, are perhaps equally ill founded; for we find excellent horses with all kinds of marks, or with no marks whatever. These little differences in the coats of horses seem to have no dependence on their dispositions or internal constitution, but take their rise from external circumstances; for a slight wound on the skin produces a white spot. Besides, Spanish horses of whatever kind are all marked in the thigh, with the signature of the stud from which they were taken. They are generally of a small stature, though some of them are four feet nine or ten inches. Those of Upper Andalusia are said to be the best, though their heads be often too long. But their other rare and excellent qualities make this fault insignificant. They are obedient, courageous, graceful, spirited, and more docile than the Barbs. For these talents they are preferred to all the horses of the world, for the purposes of war, of pomp, or of the menage.

The finest English horses in their conformation, resemble those of Arabia and Barbary, from which they originally sprung. Their heads however are too large, though handsome; and their ears are too long, but well situated. By the ears alone, an English horse may be distinguished from a Barb. But the great difference lies in their stature; for the English horses are much larger and plumper, being commonly four feet ten, and even five feet high. They are of all colours, and distinguished by every sort of mark. They are generally strong, vigorous, hardy, capable of enduring much fatigue, and excellent either for hunting or the course. But they want grace and docility; they are stiff, and have little play in their shoulders.

The English race-horses are extremely fleet, and are managed with great dexterity by their riders. I cannot give a better example than by relating the substance of a letter I received from a respectable nobleman, dated *London, Feb.* 18. 1748. Mr. Thornhill, post-master of Stilton, laid a bet, that he would ride three times the road from Stilton to London, or 215 English miles, in 15 hours. He set out from Stilton on the 29th day of April 1745, and after mounting eight different horses on the road, arrived at London in three hours fifty-one minutes. He instantly set off from London, and having mounted only six horses, he reached Stilton in three hours fifty-two minutes. For the third course, he used seven of the same horses, and finished it in three hours forty-nine minutes. So that he not only gained his bet, but instead of fifteen hours, he had performed what he had undertaken in eleven hours thirty-two minutes. I suspect that no example of such fleetness was ever exhibited at the Olympic games.

The Italian horses were formerly much handsomer than they are now; because for some time past, the breed has been neglected. However, the Neapolitan horses are still excellent for carriages. But in general they have large heads and thick necks; they are also untractable, and of course not easily managed. These defects are compensated by the stateliness of their form, by their high spirit, and by the gracefulness of their motions.

The Danish horses, both on account of size and beauty, are preferred to all others for carriages. Some of them are perfect models; but their number is small: for most of them are not very regularly formed, having thick necks, gross shoulders, backs too long and too low, and cruppers too narrow in proportion to the thickness of their fore-parts. But they are all graceful in their movements; and in general they are excellent for war and for pomp. They are of all colours; and the tiger-spotted horses are peculiar to Denmark.

Germany produces very fine horses: but though generally bred from Barbary, Turkish, Spanish, and Italian horses, most of them are heavy and short-winded; and therefore ill qualified for hunting or coursing. The horses of Hungary and Transylvania, on the contrary, are light and nimble. To prevent their neighing in time of war, and also, it is said, to improve their wind, the

Hungarians slit the nostrils of their horses. I have never had an opportunity of ascertaining the fact, that horses, whose nostrils are split, lose the power of neighing. But I should rather imagine that this operation only renders their neighing more feeble. It is remarked of the Hungarian, Croatian, and Polish horses, that they are noted for retaining what is called the mark in their teeth till they be very old.

The Dutch horses answer very well for drawing coaches, and are commonly used in France for that purpose. The best kind are brought from the province of Friesland: those of Bergue and Juliers are also very good. The Flemish horses are much inferior to the Dutch. Almost the whole of them have large heads and broad feet; and their legs are subject to humours. These two last faults render them very unfit for carriages.

In France there are horses of all kinds; but few of them are handsome. The best saddle horses are brought from the Limosin. They resemble the Barbs, and are excellent for the chase. But they grow very slowly, require much care when young, and must not be used till they arrive at the age of eight years. There are likewise good ponies in Auvergne, Poitou, and Burgundy. But next to the Limosin, Normandy furnishes the finest horses. They are not so good for the chase; but they make better war-horses. They are plump, and soon acquire their full growth. Good coach-horses, lighter and more alert than those of Holland, are bred in Lower Normandy and Cotentin. Franche-Comté and the Boulonnois furnish us with very good draught-horses. In general the French horses have their shoulders too wide, while those of the Barb are too narrow.

Having described those horses with which we are best acquainted, we shall now give the relation of travellers concerning foreign horses, of which we have little knowledge. There are good horses in all the islands of the Archipelago. Among the ancients the horses of Crete were in high estimation for agility and swiftness. However horses are now little used in that island, on account of the ruggedness of the country, which is every where mountainous and full of inequalities. The best horses in these islands, and even in Barbary, are of the Arabian race. The native horses of the kingdom of Morocco are much smaller than those of Arabia, but very nimble and vigorous. Mr. Shaw alledges, that the breed of Egypt and of Tingitania is superior to those of the neighbouring countries; and yet, more than a century ago excellent horses were found throughout all Barbary: these Barbary horses, he says, never stumble; and they stand still when the rider dismounts or drops the bridle. They walk very fast, and gallop with great rapidity; but they are never allowed to trot or amble, these movements being considered by the natives as rude and vulgar. He adds, that the Egyptian horses are superior to all others both in stature and in beauty. But these Egyptian, as well as most of the horses of Barbary, sprung originally from the Arabians, which are unquestionably the handsomest horses in the world.

According to Marmol, or rather Leo Africanus, whom Marmol has copied almost verbatim, the Arabian horses are descended from the wild horses in the deserts of Arabia, of which studs were formed very anciently, and which multiplied so greatly as to spread over all Asia and Africa. They are so swift as to out-run the ostrich. The Arabs of the desert and the people of Lybia rear numbers of these horses for the chase. They never use them either in war or for travelling. They pasture them as long as the grass remains, and when it fails they feed them with dates and camel's milk, which make them nervous, light, and meagre. They catch the wild horses in snares, and when young they eat their flesh, which they esteem as very delicate food. These wild horses are small, and commonly of an ash-colour, though some of them are white; and the hair of the mane and tail is short and crisped. Curious relations concerning the Arabian horses are given by other travellers, of which I shall only mention some of the principal facts.

There is not an Arabian, however poor, who has not his horses. The Arabs generally ride upon mares, having learned from experience, that mares endure fatigue, hunger and thirst better than horses. These mares are so gentle, that though numbers of them are often left together for whole days, they never strike or do each other the smallest injury. The Turks, on the contrary, are not fond of mares; but they purchase from the Arabs those horses which they intend not to use as stallions. The Arabs preserve with great care, and for an amazing length of time, the races of their horses. They know all their alliances and genealogies; and they distinguish their races into three different classes. The first, which are of a pure and ancient race on both sides, they call Nobles; the second are likewise of an ancient race, but have been degraded by vulgar alliances; and the third class consists of their common horses. The latter sell at a low price. But those of the first class, and even of the second, among which some individuals are not inferior to the nobles, are excessively dear. Mares of the noble class are never permitted to be covered but by horses of the same quality. The Arabs, by long experience, know all the races of their horses, as well as those of their neighbours. They know their names, surnames, colours, peculiar marks, &c. When a family have no noble stallions they borrow one of a neighbour to cover their mares, which is performed in presence of witnesses, who give an attestation of it, signed and sealed, before the secretary of the Emir, or some other public person. This attestation contains the names of the horse and mare, and a complete history of their pedigrees. When the mare has foaled, witnesses are again called, and another attestation is made, including a de-

scription of the foal, and the day of its birth. These attestations enhance the value of their horses, and they are always delivered to the purchasers. The smallest mares of this first class are worth 500 crowns; and many of them sell at 1000 crowns; and even higher prices are sometimes given. As the Arabs live in tents, these tents serve them likewise for stables. The mare and her foal, the husband and his wife and children, sleep together promiscuously. The infants often lie on the body, or on the neck of the mare or foal without receiving any injury from these animals, which seem afraid to move, lest they should hurt the children. These mares are so accustomed to society, that they submit to every kind of familiarity. The Arabs never beat their mares; but treat them gently, and talk and reason with them. They are so careful of them as to allow them always to walk, and never spur them, unless the occasion be very urgent. Hence whenever the creatures perceive the rider's heel make an approach to their sides, they instantly set off with incredible swiftness, and leap hedges and ditches as nimbly as stags. If their rider chances to fall, they are so well trained that they stop short, even in the most rapid gallop. All the Arabian horses are of a middle stature, very easy in their carriage, and rather meagre than fat. They are dressed every morning and evening with so much care that not a spot of dirt is left on their skin, and their legs, mane, and tail, are washed. Their tails are allowed to grow long; and the comb is seldom used, to prevent the hair from being broken. During the day they are not permitted to eat; but are watered twice or thrice. At sunset, a bag containing about half a bushel of barley is passed over their heads, and fastened to the neck. This bag is not removed till next morning, when the barley is entirely consumed. In the month of March, when the grass is good, they are turned out to pasture. This is also the season in which the mares are covered; and on these occasions water is employed in the same manner as in other countries. After the spring is past, the horses are taken from the pasture; and during the rest of the year they are allowed neither grass nor hay, and rarely straw, barley being their only food. At the age of a year or ten months the Arabians cut the manes of their foals, with a view to make them grow long and bushy. When two years, or two years and a half old, they are mounted, having never before that period been either saddled or bridled. Every day, from morning to night, all the Arabian horses stand saddled at the tent-doors.

This race of horses is spread over all Barbary; and the great men among the Moors, and even among the Negroes along the rivers Gambia and Senegal, have Arabian horses of great beauty. Instead of barley or oats, they are fed with maize reduced to a powder, which is mixed with milk, when they require to be fattened. In this warm climate they are allowed little water. On the other hand the Arabian horses are dispersed over Egypt, Turkey, and perhaps Persia, where very considerable studs were formerly kept. Marc Paul mentions one of these studs which contained ten thousand white mares; and he says, that in the province of Balascia there is a vast number of large nimble horses, with hoofs so hard as to require no shoes.

The Levant horses, like those of Persia and Arabia, have very hard hoofs; they are shoed however, but with shoes extremely light and thin. In Turkey, Persia, and Arabia, the same manner of feeding and dressing horses is observed. Their litter is made of their own dung, which is first dried in the sun, to remove the disagreeable smell, and then reduced to a powder. Of this a bed is laid in the stable or tent, about four or five inches thick. This litter lasts very long; for after being soiled, it is dried a second time in the sun, which clears it entirely from its offensive odour.

In Turkey there are Arabian, Tartarian, and Hungarian horses, beside the native horses of that country, which last are exceedingly handsome, swift, and spirited. But they are delicate, and soon fatigued. They eat little, are easily heated, and their skin is so sensible that they are unable to bear the friction of a comb; instead of which they are brushed and washed with water. These horses, though beautiful, are inferior to the Arabians, and even to those of Persia; the latter, next to the Arabians, being the handsomest and best horses of the East. The pasture in the plains of Media, of Persepolis, of Ardebil, and of Derbent, is extremely fine; and a prodigious quantity of horses, most of which are beautiful and excellent, are raised there by order of government. Pietro della Valle prefers the common horses of Persia to the finest Neapolitan Horses. They are generally of a middle stature; and some of them are very small, but strong and active; while others exceed the size of the English saddle-horses. They have light heads and fine necks. Their ears are handsome and well situated. They have slender legs, fine cruppers, and hard hoofs. They are docile, spirited, bold, and capable of enduring great fatigue. They are extremely swift, and never stumble. They are robust, and so easily nourished, that their only food is barley mixed with cut straw; and they are grazed during six weeks of the spring only. Their tails are allowed to grow long; and they are never gelded. Coverings are used to defend them from the injuries of the weather. Peculiar care and attention are bestowed upon them; and they are managed by a simple bridle, without employing the spur. Great numbers of them are transported to Turkey and the Indies. Those travellers who bestow so much praise upon the Persian horses allow, however, that the Arabians are superior in agility, courage, strength, and beauty; and that they are more valued, even in Persia, than the horses of that country.

The horses which are bred in the Indies are very indifferent. Those used by the great men of the country are brought from Persia and Arabia. They are fed with hay during the day; and at night, in place of barley and oats, they get pease boiled with sugar and butter. This nourishing diet supports them, and gives them some degree of strength; without it, they would soon perish, the climate not being adapted to their constitution. The native horses of India are very small. Some of them are so exceedingly diminutive, that Tavernier informs us, the young Prince of Mogul, aged about seven or eight years, generally rode on a handsome little creature, whose stature exceeded not that of a large greyhound. Very warm climates, it would appear, are destructive to horses. Those of the Gold Coast, of Juida, of Guinea, &c. are likewise extremely bad. They carry their head and neck very low. Their movements are so feeble and tottering, that one is apt to imagine they are always ready to fall. If not continually beat, they would not stir a limb; and the greatest part of them are so short, that the feet of the rider almost touch the ground. They are besides very untractable, and fit only to be eaten by the Negroes, who are equally fond of horses' flesh as that of dogs. This appetite for horses' flesh is common to the Negroes and Arabians, and discovers itself in Tartary, and even in China. The Chinese horses are as bad as those of India, being feeble, sluggish, ill-made, and very small. Those of Corea exceed not three feet in height. Almost all the horses of China are gelded; and they are so timid, that they cannot be used in war. It may indeed be affirmed, that the Tartarian horses made the conquest of China. The horses of Tartary are very proper for the purposes of war. Though not of the largest size, they are strong, vigorous, bold, fiery, and extremely swift. Their hoofs are hard, but too narrow; their heads are light, but too small; their necks are long and stiff; and their limbs are too long. Notwithstanding these faults, they may be regarded as good horses; for they are indefatigable, and run with amazing rapidity. The Tartars, like the Arabians, live with their horses. At the age of seven or eight months they are mounted by children, who walk and gallop them by turns. In this manner they are gradually trained; and they are accustomed to suffer long abstinence. But they are not mounted for hunting or travelling, till they arrive at six or seven years of age, when they are obliged to undergo the most incredible fatigues; as walking two or three days without stopping; receiving for four or five days together, only a handful of herbage every eight hours; and at the same time, they are kept from drinking for 24 hours, &c. These horses, which are so robust in their own country, become feeble and useless when transported to China or the Indies: but they thrive very well in Persia and Turkey. In Little Tartary, there is a race of small horses, of which the natives are so fond, that they never permit these horses to be sold to strangers. They possess all the good and bad qualities peculiar to the horses of Great Tartary; which shows that the influence of the same manners and education create in these animals the same dispositions and temperament. In Circassia and Mingrelia, there are many horses still handsomer than those of Tartary. Fine horses are also to be found in the Ukraine, in Wallachia, in Poland, and in Sweden. But we have no particular information concerning their excellencies or defects.

If we consult the ancients as to the qualities of horses in different countries, we shall find that the Greek horses, and especially those of Thessaly and Epirus, were in high estimation, and were excellent for the purposes of war; that those of Achaia were the largest then known; that the handsomest came from Egypt, where they were very numerous, and where Solomon sent to purchase them at a very high price; that in Ethiopia, on account of the great heat of the climate, the horses did not thrive; that Arabia and Africa furnished the handsomest, lightest, and best horses, either for travelling or for the course; that those of Italy, and particularly of Apulia, were likewise very good; that Sicily, Cappadocia, Syria, Armenia, Media, and Persia, produced excellent horses, which were remarkable for lightness and fleetness; that those of Sardinia and Corsica were small, but bold and vivacious; that the horses of Spain resembled those of Parthia, and excelled in war; that in Transylvania and Wallachia, there were swift horses, with light heads, long manes which hang down to the ground, and bushy tails; that the Danish horses were handsome, and fine leapers; that those of Scandinavia were small, but well-formed, and very agile; that the horses of Flanders were remarkable for strength; that the Gauls furnished the Romans with good horses for the purposes of riding and carrying burdens; that the German horses were ill-formed, and so vicious, that no use was made of them; that the horses of Switzerland were numerous, and useful in war; that those of Hungary were also very good; and lastly, that the Indian horses were small and very feeble.

From all these facts, it is apparent that the Arabian horses have always been, and still are, the best horses of the world, both for beauty and goodness; that from them, either directly, or by the mediation of the Barbs, are derived the finest horses in Europe, in Africa, and in Asia; that Arabia is, perhaps, not only the original climate of horses, but the best suited to their constitution; since, instead of crossing the breed by foreign horses, the natives anxiously preserve the purity of their own race; that at least, if Arabia be not the best climate for horses, the Arabs have produced the same effect, by the scrupulous and perpetual attention they have paid towards ennobling the race, and never permitting

individuals to mix which were not the most handsome, and of the finest quality; and that by the same attention continued for ages, they have improved the species far beyond what Nature would have performed in the most favourable climate. It may still farther be concluded, that climates rather warm than cold, and above all, dry countries, are best adapted to the nature of horses; that in general, the small are better than the large horses; that care is equally necessary to them as food; that by familiarity and caresses, we procure more advantage from them, than by force and chastisement; that the horses of warm countries have their bones, hoofs, and muscles, more firm and compact than those of our climates; that though heat is more conformable to the nature of these animals than cold, yet excessive heat is exceedingly hurtful to them; that excessive cold is not less injurious; and in fine, that their constitution and dispositions depend almost entirely upon climate, food, care, and education.

The practice of gelding horses, so generally diffused over Europe and China, is unknown in Persia, Arabia, and many other parts of the east. This operation greatly diminishes their strength, courage, sprightliness, &c.; but it endows them with gentleness, tranquillity, and docility. In performing it, the animal is thrown on his back, by means of ropes fixed to his legs; the scrotum is opened with a sharp knife; and the testes, with their vessels, and the ligaments which support them, are removed. The wound is then closed up; and the patient is bathed twice a day with cold water. His food during this period, consists of bran drenched in water, with a view to cool him. The operation should be performed in spring or autumn, much heat or much cold being equally dangerous. With regard to the age at which it should be executed, the practice differs in different places. In certain provinces of France, horses are gelded at the age of a year or eighteen months, or as soon as the testes are very apparent without the body. But the most general and most rational custom is to delay the operation till the age of two or three years; because when protracted this long, the animal retains more of the qualities peculiar to the male sex. Pliny says, that if a horse be gelded before he loses his milk-teeth, they never shed. But I know from repeated observation, that this remark is false. The ancients, it is probable, were led into this error, by an analogy drawn from the stag, roe-buck, &c.; for the horns of these animals never fall off after castration. Geldings lose the power of impregnating; but there are many examples of their being still able to copulate.

Horses of all colours, like most animals covered with hair, moult or cast their hair every year, commonly in the spring, and sometimes in autumn. As they are then weaker than at any other period, they require more care, and should be more plentifully fed. Some horses likewise cast their hoofs, especially in moist and marshy countries, as in Holland.

Mares and geldings neigh less frequently than perfect horses. Their voices are also neither so full nor so deep. In horses of every kind, five different species of neighing, expressive of different passions, may be distinguished. In the neigh proceeding from joy, the voice is long protracted, and begins and terminates with sharp sounds: the horse at the same time flings, but without any inclination to strike. In the neigh of desire, whether from love or friendship, the horse does not fling, the voice is long continued, and finishes with graver sounds. The neigh of anger, during which the animal flings and strikes with fury, is very short and sharp. The neigh of fear, during which he also flings, is not longer than that of anger; the voice is grave and hoarse, and seems as if it proceeded entirely from the nostrils. This neigh resembles the roaring of a lion. The noise expressive of pain is not so much a neigh as a groan or snorting uttered with a grave voice, and following the alternate motions of respiration. It has likewise been remarked that horses which neigh most frequently from motives of joy or desire, are the best and most generous. The voice of unmutilated horses is stronger than that of geldings or mares. The female voice, even from the moment of birth, is weaker than that of the male. At two years, or two and a half, which is the age of puberty, the voice both of males and females, as in man and other animals, becomes stronger and more grave.

When the horse is fired with love, he shows his teeth, and has the appearance of laughing. He likewise shows them when angry and inclined to bite. He sometimes thrusts out his tongue to lick, but less frequently than the ox, though the latter is less sensible of caresses. The horse remembers injuries much longer than the ox, and is also more easily dispirited. His natural disposition, which is bold and impetuous, makes him exert his whole force at once; and when he perceives that still more is requisite, he grows indignant, and obstinately refuses to act. But the ox, who is naturally slow and slothful, seldom employs his whole strength, and is not so easily disheartened.

The horse sleeps much less than man. When in good health, he never lies above two or three hours at a time. He then rises to eat. After being much fatigued, and after filling his belly, he lies down a second time. But upon the whole, he sleeps not above three or four hours in the twenty-four. There are also some horses which never lie down, but sleep standing; and even those which are accustomed to lie down, sometimes sleep on their feet. It has been remarked, that geldings sleep oftener and longer than perfect horses.

All quadrupeds drink not in the same manner, though all are under an equal necessity of exploring with the head that liquor which they have no other method of

apprehending, except the monkey, and some other animals that have hands, and can drink like man, when a proper vessel is presented to them; for they carry it to their mouth, pour out the liquor, and swallow it by the simple movement of deglutition. This is the ordinary way in which man drinks, because it is the most commodious. But he can vary his method of drinking, by contracting the lips and sucking the fluid, or rather by sinking both mouth and nose into it, and then performing the motions necessary to swallowing. He can even seize a fluid by the simple motion of his lips; or lastly, he can stretch out and expand his tongue, make a kind of little cup of it, and in this manner, though with some difficulty, satisfy his thirst. Most quadrupeds might also drink in different ways: but, like man, they follow that which is most convenient. The dog, whose mouth opens wide, and whose tongue is long and slender, drinks by lapping, or licking with his tongue, which he forms into a kind of cup or scoop, fills at each time, and thus carries a sufficient quantity of fluid into his mouth. This method he prefers to that of dipping his nose into the water. The horse, on the contrary, whose mouth is too small, and whose tongue is too thick and too short for forming a scoop, and who besides drinks with more avidity than he eats, briskly sinks his mouth and nose deep into the water, which he swallows plentifully by the simple motion of deglutition. But this obliges him to drink without drawing his breath; while the dog respires at his nose during the time he is drinking. After running, when respiration is short and laborious, horses should be allowed to drink at leisure, and to breathe as often as they incline. Neither should they be permitted to drink water that is too cold; for independent of the colics frequently occasioned by very cold water, it often cools their nose to such a degree as brings on rheums, and perhaps lays the foundation of the disease called glanders, the most obstinate of all maladies to which this noble animal is subject. It has lately been discovered that this disease is seated in the pituitary membrane; and that it is a genuine rheum, which in time produces an inflammation in that membrane. Besides, those travellers who give a detail of the diseases of horses in warm countries, alledge not that the glanders is equally frequent in Arabia, Persia, and Barbary, as in cold climates. Hence I am led to conjecture, that this malady is owing to the superior coldness of the water; because these animals are obliged to keep their noses in the water a considerable time, which might be prevented by never allowing them to drink very cold water, and by always drying their nostrils after drinking. Asses, which dread cold more than horses, and resemble them so greatly in their internal structure, are not equally subject to the glanders, which is owing perhaps to their drinking in a different manner from the horse; for instead of sinking the nose into the water, they barely touch it with their lips.

I shall mention no more of the diseases of horses. It would extend Natural History beyond all bounds, if to the history of each animal we were to join that of its diseases. However, I cannot finish the history of the horse without regretting that the health of this useful and valuable animal should be still abandoned to the blind care, and often absurd and cruel practice of a set of men who have neither understanding nor letters. Of the art called by the ancients Medicina Veterinaria, we now hardly know more than the name. If any physician would turn his views to this subject, and make it a principal object of his inquiry, I am convinced that he would be amply rewarded for his trouble; and that he would not only acquire a fortune, but obtain the highest reputation. This species of the medical art would by no means be conjectural, or so difficult as the other. The manners, the food, the influence of sentiment, and all the other causes of disorders, being less complicated in these animals than in man, their diseases must also be more simple, and of course more easily investigated and treated with success. To these advantages may be added the perfect liberty of making experiments, of trying new remedies, and of arriving, without fear or reproach, to a most extensive knowledge of this kind, from which, by analogy, deductions might be drawn of the greatest utility to the art of curing men.

SUPPLEMENT

WE have already described the manner in which the horses of Arabia are treated, and given a detail of the pains and attention bestowed on their education. This dry and warm country, which appears to be the original climate of the horse, and most conformable to his nature, permits or requires a number of usages that cannot be practised with equal effect in any other region. In France, and other northern nations, it is impracticable to train and feed horses in the same way as in warm climates. But men, who are interested in these useful creatures, will not be displeased to learn how they are managed in countries less favoured by heaven than Arabia, and how they conduct themselves, when they act independent of the human species, and when left entirely to their own dispositions and instincts.

Horses are differently fed, according to the different countries to which they are transported, and the uses to which they are destined. The horses of Arabia or Barbary, which are destined for hunting, seldom eat herbage or grain. Their common food, which consists of dates and camels milk, is given them every morning and evening. These aliments, instead of fattening the horses, render them meagre, nervous, and very fleet. They spontaneously suck the she-camels, whom they follow till the time they are ready for mounting, which is not before the age of six or seven years.

In Persia the horses are exposed night and day to the open air. But to protect them from the injuries of the weather, from damp vapours, and from rain, they are covered, especially in winter, with cloths; and sometimes an additional covering is added, which is made of hair, and very thick. A spot of dry level ground is prepared for them, which is greater or smaller according to their number, and kept extremely clean. Here they are all tied to a long rope, which is well stretched, and firmly fixed at each end to two iron rods stuck in the earth. Their halters however are sufficiently free to allow them to move with ease. To prevent them from hurting each other, their hind legs are tied with a rope, which has iron buckles at each extremity; these are brought about to the fore part of the hores, and fastened to the ground by pegs, but loose enough to allow them to lie down or to rise at their pleasure. When put into stables, they are managed in the same manner. Xenophon informs us, that this practice was observed in his days: and it is alledged, that by this means the animals are rendered more gentle and tractable, and less peevish among themselves; qualities extremely useful in war, when vicious horses, tied up in squadrons, often injure one another. For litter the Persians use only sand or dry dust, upon which their horses lie down and sleep as well as if it were straw. In other countries, as Arabia and the Mogul empire, the horses are littered with their own dung, well dried and reduced to a powder. The eastern horses are never allowed to eat from the ground, or even from a rack; but are served with barley and cut straw in pocks tied to their heads; for in these climates no hay is made, nor do the natives cultivate oats. In spring the horses are fed with grass or green barley, and great care is taken to give them as much only as is barely necessary; for too much nourishment makes their legs swell, and soon renders them useless. These horses, though ridden without bridle or stirrups, are easily managed. They carry their heads very high, by means of a simple snaffle, and run with great rapidity and sureness upon the worst roads. The whip and spur are very seldom employed. The latter, when used, consists only of a single point fixed to the heel of the boot. Their common whips are made of small strips of parchment knotted and twisted. A few lashes with this whip are sufficient for every purpose of the rider.

Horses are so numerous in Persia, that though excellent, they sell cheap. Some of them are very tall and heavy; but all of them are more remarkable for strength than for gracefulness and beauty. For easy travelling the Persians use pacing horses, which are taught this motion by tying the fore foot to the hind foot on the same side: when young their nostrils are slit, from a notion that it makes them breathe more freely. These horses travel so well, that they perform with ease a journey of eight leagues without stopping.

But Arabia, Barbary, and Persia, are not the only climates which produce good and handsome horses. Even in the coldest countries, if not too moist, these animals succeed better than in very warm climates. The beauty of the Danish horses, and the excellence of those of Sweden, Poland, &c. are universally known. In Iceland, where the cold is excessive, and where often no other food can be had than dried fishes, the horses, though small, are extremely vigorous; some of them are indeed so diminutive as to be fit for carrying children only. Besides, they are so plentiful in this island, that the shepherds tend their flocks on horseback.

Their number is not expensive; for their food costs almost nothing. Such as the owners can apply to no immediate use, they mark, and turn out to the mountains. There they soon become wild; and when wanted, are hunted in troops, and caught with long ropes. When the mares foal in the mountains, the proprietors put their peculiar marks on the young, and leave them there for three years. Those horses which are brought up in the mountains, are generally more handsome, bold, and fleet, than those reared in stables.

The Norwegian horses are likewise small, but well proportioned. Most of them are yellow, with a black line running the whole length of the back. Some of them are of a chesnut, and others of an iron-gray colour. These horses are very sure footed, travel with great caution through the rough paths of the mountains, and slide down steep declivities, by bringing their hind-feet under their bellies. They defend themselves against the assaults of the bear. When a stallion, in company with mares or foals, perceives this voracious animal, he makes them stay behind, approaches, and boldly attacks the enemy, whom he beats with his fore-feet, and generally kills. But if the horses attempt to defend themselves by striking with their hind-feet, they are infallibly gone; for the bear leaps upon their backs, where he sticks with such force that he suffocates them in a short time.

The horses of Nordland never exceed four feet and a half in height. The nearer we approach to the pole, we find that horses become smaller and weaker. Those of West Nordland are of a singular form. They have large heads and eyes, short necks, large poitrels, narrow withers, long thick bodies, short loins; the upper part of their legs is long, and the under short and naked; their hoofs are small and hard; their tales and manes are large and bushy; and their feet are small, but sure, and never defended with shoes. These horses are good, seldom restive or stubborn, and climb with patience the highest mountains. The pasture in Nordland is so excellent, that when horses are brought from thence to Stockholm, they seldom remain above a year without losing their flesh and their vigour. On the contrary, when horses are carried from more northern countries to Nordland, though sickly for the first year, they recover their strength.

Excess of heat or of cold seem to be equally hostile to the stature of horses. The Japanese horses are generally small, though some of them are of a tolerable size. The latter probably come from the mountains of that country. The same remark applies to the horses of China. We are assured, however, that those of Tonquin are nervous, of a good size, gentle, and easily trained to any kind of exercise.

It is well known that horses bred in dry warm climates degenerate, and even cannot live, in moist countries, however warm. But they succeed very well in all the mountainous countries of our continent, from Arabia to Denmark and Tartary, and in America, from New Spain to the land of Magellan. It is therefore neither heat nor cold, but moisture alone, that is noxious to these animals.

There were no horses in America when it was discovered. But in less than two centuries after a small number of them had been transported thither from Europe, they multiplied so prodigiously, especially in Chili, that they sold at very low prices. Frezier remarks, that this great increase was still more surprising, because the Indians eat horses, and kill many of them by fatigue and bad management. The horses carried by the Europeans to the most eastern parts of our continent, as the Philippine islands, have likewise multiplied exceedingly.

In the Ukraine, and among the Cossacks along the river Don, the horses live wild in the fields and forests. In that large and thinly peopled country comprehended between the Don and the Nieper, the horses go in troops of three, four, or five hundred, and have no shelter even when the ground is covered with snow, which they remove with their fore-feet in quest of food. These troops are guarded by two or three men on horseback; and it is only in severe winters that they are lodged for a few days in the villages, which in this country are very distant from each other. These troops of horses give rise to some remarks, which seem to prove that men are not the only animals that live in society, and obey by compact the commands of one of their own number. Each of these troops has a chief whom the individuals implicitly obey; he directs their course, and makes them proceed or stop at his pleasure. This chief likewise gives orders for the necessary arrangements and motions, when the troop is attacked by robbers or by wolves. He is extremely vigilant and alert: he frequently runs round the troop; and when he finds any horses out of their rank, or lagging behind, he gives them a push with his shoulder, and obliges them to take their proper stations. These animals, without being mounted or conducted by men, march nearly in as good order as our trained cavalry. Though at perfect liberty, they pasture in files and brigades, and form different companies, without ever mixing or separating. The chief occupies this important and fatiguing office for four or five years. When he becomes weaker and less active, another horse, ambitious of command, and who feels his own strength, springs out from the troop, attacks the old chief, who if not vanquished, keeps his command; but if beat, enters with shame into the common herd; and the conqueror takes the lead, is recognized as sovereign, and obeyed by the whole troop.

In Finland, when the snows are dissolved in the month of May, the horses depart from their masters, and go into certain districts of the forests, as if they had previously fixed a rendezvous. There they form different troops, which never separate or intermix. Each troop takes a different district of the forest for pasturing. To this territory they confine themselves, and never encroach on the lands belonging to other troops. When the grass is exhausted, they decamp and take possession of a fresh pasturage in the same order as before. The police of their society is so well regulated, and their marches so uniform, that their owners always know where to find their horses, when they have occasion for them; and those which are carried off, after having performed their task, return of their own accord to their companions in the woods. In the month of September, when the weather turns bad, they quit the forest, march home in troops, and each takes possession of his own stable.

These horses are small, but good and spirited, without being vicious. Though generally very docile, some of them resist, when their owners offer to take them, or to yoke them in carriages. When they return from the forests, they are fat and in fine order. But the perpetual labour they undergo during the winter, and the small quantity of food they receive, soon make them lose their flesh. They roll on the snow as other horses do on the grass. They pass the night, indifferently, either in the court yard or in the stable, even during the most violent frosts.

These horses which live in troops, and are often removed from the dominion of man, form the link or shade between domestic and wild horses. Of the latter there are some in the island of St. Helena, which after being transported thither from Europe, become so savage and ferocious, that rather than suffer themselves to be taken, they would leap over the highest precipices into the sea. In the environs of Nippes, some of them are not larger than asses; but they are rounder, and well proportioned. They are vivacious, indefatigable, and possess a strength and dexterity beyond what could be expected. In Saint Domingo, the horses are of a middle stature, and much esteemed. Numbers of them are taken with snares and ropes; but most of these continue to be extremely restive and skittish. There are also horses in Virginia, which, though sprung from the domestic kind, have become so ferocious in the woods, that it is difficult to approach them, and when taken, they belong to the person who apprehends them. They are commonly so stubborn that it is not easy to tame them. In Tartary, and particularly in the country between Urgenz and the Caspian sea, birds of prey are employed in hunting wild horses. These birds are trained to seize the horse by the neck and head, who fatigues himself by running, but is unable to disengage himself from his tormentor. The wild horses in the country of the Mongous and Kakas Tartars, differ not from those which are tame. They are found in great numbers upon the western coast; and some appear in the country of the Kakas which borders on the Harni. These wild horses are so swift, that they often escape the arrows of the most dexterous hunters. They march in numerous troops; and when they chance to meet with tamed horses, they surround them and oblige them to fly. In Congo, considerable numbers of wild horses are still to be found. They are sometimes seen also in the environs of the Cape of Good Hope; but they are seldom taken, because the inhabitants prefer the horses transported from Persia.

When formerly treating of the horse, I remarked, that from all the observations of the breeders of horses, the male appeared to have greater influence upon the offspring than the female; and I then gave some reasons which rendered the universality of this fact doubtful, and even made it probable that the influence of the male and female were equal. But numerous experiments and observations have now convinced me, that not only in horses, but in man and every other animal, the male has more influence on the external form of the young than the female, and that in every species the male is the principal type of the race.

I have said that in the common order of Nature, it is not the males, but the females, which constitute the unity of the species: but this prevents not the male from being the true type of each species; and what I have advanced concerning unity, ought to be extended only to the greater facility of representing the species possessed by the female, though she submits to the embraces of different males. This point I have fully discussed in my history of birds, and in the present work, under the article Mule; from which it appears, that though the female seems to have more influence upon the specific character of the breed, she never improves it, the male alone enjoying the faculty of supporting the purity of the race, and of rendering it more perfect.

THE ASS.

THE ass has long slouching ears and a short mane. The tail is covered with long hairs at its termination only; and the body is generally of an ash colour with a black bar across the shoulders. His hoof consists of one piece; and he has six cutting teeth in each jaw.

This animal, even when examined with minute attention, has the appearance of a degenerated horse. The exact similarity in the structure of the brain, lungs, stomach, intestinal canal, heart, liver, and other viscera, and the great resemblance of the body, legs, feet, and whole skeleton, seem to support this opinion. The slight differences which take place between these two animals may be attributed to the long continued influence of climate and food, and to a fortuitous succession of many generations of small wild horses, who, by gradually degenerating, at last produced a new and permanent species, or rather a race of similar individuals, all marked with the same defects, and differing so widely from the genuine horse, as to be regarded as constituting a new species. The greater variety of the colour of horses than of asses appears to favour this idea: this circumstance shows that the former have been longer in a domestic state; for the colour of all domestic animals varies much more than that of wild ones of the same species. Besides, the wild horses mentioned by travellers are generally small, and have, like the ass, grey hair and a naked tail, tufted at the extremity. Some wild, as well as domestic horses, have likewise a black line on the back, and other characters which make them nearly approach to the ass.

In his disposition, the ass is equally humble, patient, and tranquil, as the horse is proud, ardent, and impetuous. Chastisement and blows he endures with constancy, and perhaps with courage. He is temperate both as to the quantity and quality of his food. He eats contentedly the hardest and most disagreeable herbage, which the horse and other animals pass by and disdain. With regard to water he is extremely nice. He drinks only from the clearest brooks he can find. In drinking he is equally moderate as in eating. He never sinks his nose in the water, being afraid, as has been alledged, of the shadow of his ears. As nobody takes the trouble of combing him, he often rolls on the grass among thistles or ferns. Without paying any regard to the load he carries, he lies down and rolls as often as he can, seemingly with a view to reproach the neglect of his master; for he never wallows, like the horse, in the mire or in water. He is even afraid of wetting his feet, and turns off the road to avoid a puddle. His legs are also drier and cleaner than those of the horse. He is so susceptible of education as to be sometimes exhibited in public shews.

The ass, when young, is gay, handsome nimble, and even graceful. But, whether from age or maltreatment, he soon loses these qualities, and becomes sluggish, untractable, and stubborn. He discovers no ardour but in love. When under the influence of this passion, he is so furious that nothing can restrain him; and by excessive indulgence he sometimes dies soon after gratification. As his love rises to a degree of madness, his attachment to his progeny is likewise excessive. We are told by Pliny, that when the young is separated from the mother, she will pass through flames to rejoin it. Though commonly abused, the ass has a great affection for his master, whom he scents at a distance, and distinguishes him from every other person. He knows likewise the places where his master puts up, and the roads which he frequents. His eyes are exceedingly good; his sense of smelling is admirable, especially when in quest of a female. His ear is excellent, which has contributed to make him be ranked among the timid animals, who are all said to have long ears and acute hearing. When oppressed with too great a load, he discovers his uneasiness by inclining his head, and lowering his ears. When tormented by abuse, he opens his mouth and draws back his lips in a most disagreeable manner, which gives him an air of scorn and derision. If his eyes be covered, he stands immoveably still; and when lying on one side, if the one eye rests on the ground, and the other be covered with a stone or any other opaque body, he will continue in that situation without making the smallest effort to rise. He walks, trots, and gallops like the horse: but all his movements are slower and more circumscribed. Though he can run, when he first sets out, with considerable swiftness, he continues his career only for a short time; and whatever pace he assumes, if pushed hard, he is soon fatigued.

The horse neighs; but the ass brays: the last is performed by a very loud, long, disagreeable, discordant cry, consisting of discords alternately sharp and flat. He seldom brays but when pressed with hunger or love. The voice of the female is more clear and piercing than that of the male. When gelded the ass brays with a low voice; and though he makes the same efforts and

the same motions of the throat, yet the sound reaches to no great distance.

Of all quadrupeds the ass is least infested with lice or other vermin, which seems to be owing to the superior hardness and dryness of his skin. For the same reason, he is less sensible to the whip, or the stinging of flies, than the horse.

At the age of two years and a half, the first middle cutting teeth fall out, and the others on each side soon follow. They are replaced in the same time and in the same order as those of the horse. The age of the ass is also distinguishable, as in the horse, by the same marks in the teeth.

The ass, when two years and a half old, is capable of procreating. The female is still more early, and equally lascivious, which last is assigned as the reason for her want of fecundity. She rejects the cause of conception, unless the ardour of her desire be repressed by blows. Without this precaution, she is seldom impregnated. The ordinary season of love is the months of May and June. When pregnant she soon becomes cool; and in the eighth month the milk appears in her paps. In the twelfth month she brings forth; and solid masses are often found in the liquor of the amnios similar to the hippomanes of the foal. Seven days after delivery, her ardour returns, and she is in a condition to receive the male. Thus the female ass may be said to be capable of perpetually nourishing and engendering. She produces but one colt; and there are very few examples of her bringing forth two at a time. At the end of five or six months the colt may be weaned, especially if the mother be pregnant, to enable her to afford proper nourishment to the fœtus. The jack-ass should be chosen from the largest and strongest of his species. He should be at least three years of age, and should never exceed ten. He should have long limbs, a strong body, an elevated and small head, vivacious eyes, large nostrils and chest, fleshy loins, broad ribs, flat buttocks, a short tail, and shining soft hair of a deep grey colour.

The ass, like the horse, takes three or four years before he arrives at full maturity; and of course he lives to the age of 25 or 30 years. The females are said to live longer than the males. But this circumstance is probably owing to the females being often pregnant, and more humanely treated; while the males are perpetually persecuted with blows and excessive labour. They sleep less than the horse, and never lie down to sleep but after vast fatigue. The jack-ass lives longer than the stallion. The ardour of the former increases with his years; and, in general, the health of this animal is more permanent and established than that of the horse. The ass is less delicate, and subject to much fewer distempers. The ancients mention no other disease of the ass but the glanders, to which, as formerly remarked, he is still less liable than the horse.

Of asses there are different races as well as of horses: but they are not equally known; because they have neither been taken care of nor traced with the same attention. It cannot however admit of a doubt that they all originated from warm climates. Aristotle assures us, that in his time there were no horses in Scythia, or other northern nations, nor even in France, the climate of which, he remarks, was too cold: he adds, that cold climates either render them barren, or make them degenerate, which is the reason why they are small and feeble in Illyrica, Thracia, and Epirus. They are still so in France, though they have been long naturalized, and though, within these two thousand years, the cold of the climate has been greatly diminished by the cutting down of vast forests, and the draining of marshes. But it is more certain, that they have not long resided in Sweden and other northern countries. They appear to have come originally from Arabia, and to have passed from Arabia to Egypt, from Egypt to Greece, from Greece to Italy, from Italy to France, and from thence to Germany, Britain, Sweden, &c.; for it is a known fact, that they are weak and small in proportion to the coldness of the climate.

This migration appears to be well supported by the relations of travellers. Chardin remarks, 'That there 'are two kinds of asses in Persia, one of which is slow 'and heavy, and used only for carrying burdens; the 'other race come from Arabia, and are the handsomest 'and finest asses in the world. They have a glossy 'skin, a high head, and nimble limbs: they move well, 'and are employed for riding only. The saddles which 'are put upon them resemble round pannels, flattened 'above. They are made of woollen cloth, or of tapestry, 'with trappings and stirrups. The rider sits nearer the 'crupper than the neck. Some of these asses cost 400 'livres, and they cannot be had for less than 25 pistoles. 'They are dressed like horses, and are never taught any 'motion but that of pacing. The art of training them 'consists of tying each fore-foot to the hind foot of the 'same side with two cords, which are made of the length 'that the ass is to pace, and are suspended by another 'cord passed under the girth to the stirrup-leather. 'They are trained by grooms every morning and even-'ing to this kind of motion. Their noses are slit to 'make them breathe more freely; and they go so quick 'that a horse must gallop in order to keep up with 'them.'

It were to be wished that the Arabians, who preserve with so much care, and for so long a time, the races of their horses, would pay equal attention to their asses: from the above passage, and other sources of information, however, it appears that Arabia is the original and best climate for both animals. From Arabia the asses passed into Barbary and Egypt, where they are large and handsome. In India and Guinea, they are larger,

stronger, and more useful than the horses of these countries. They are in high estimation at Madura, where one of the most considerable tribes of Indians revere them in a peculiar manner, because they believe that the souls of all the nobility pass into the bodies of asses. Lastly, the number of asses exceeds that of horses in all the southern regions from Senegal to China. Wild asses are likewise more common than wild horses. The Latins, copying the Greeks, called the wild ass Onager, which should not be confounded, as most naturalists and travellers have done, with the zebra, because the zebra is an animal of a different species from that of the ass. The onager, or wild ass, is not striped like the zebra, and is not nearly of so elegant a figure. Wild asses are found in some of the islands of the Archipelago, and particularly in that of Cerigo. There are many of them in the deserts of Lybia and Numidia. They are gray, and run so fleet, that they can only be overtaken in the chase by the best Barbary horses. When they see a man, they give a loud cry, fling up their heels, stop, and fly not till he makes a near approach. They are caught in snares and gins made of ropes. They pasture in troops; and their flesh is eaten by the natives. In the days of Marmol, there were wild asses in Sardinia; but they were smaller than those of Africa; and Pietro della Valle says, that he saw a wild ass in Bassora. He differed not in figure from the domestic ass, only his colour was clearer, and he had from the head to the tail, a line of white hair. He was also more vivacious and swifter than common asses. Olearius relates, that one day the King of Persia invited him to the top of a small building, in the form of a theatre, to partake of a collation of fruits and sweet-meats; that after the repast, thirty-two wild asses were introduced; that the King amused himself by shooting a few bullets and arrows at them; that he then allowed the same privilege to some of the nobility and ambassadors; that it was no small entertainment to see these asses running about, biting, and kicking each other, with several arrows sticking in their bodies; and that when the whole were killed in presence of the King, they were sent to Ispahan for the royal family, the Persians being extremely fond of ass's flesh, &c. It does not appear, however, that all these 32 wild asses were taken in the forests: it is more probable that they were brought up in large parks for the pleasure of chasing and eating them.

Neither asses nor horses were found in America, though the climate of South America is very agreeable to their nature. Those transported thither by the Spaniards, and left in large islands, or in the Continent, have multiplied exceedingly. They pasture in troops, and are taken by snares, like the wild horses.

The jack-ass and mare produce the large mules; and the horse and she-ass produce the smaller mules, which differ in several respects, from the former. But as we mean to treat of the generation of mules, jumars, &c. in a separate dissertation, we shall finish the history of the ass with the uses men derive from this animal.

Wild asses being unknown in our climates, we cannot determine whether their flesh makes a wholesome or savoury dish. But this we know, that the flesh of the domestic ass is worse, harder, and more disagreeably insipid than that of the horse. Galen says, that it is a pernicious aliment, and produces diseases. The milk of the ass, on the contrary, is an approved remedy against certain distempers. The use of this remedy has been transmitted to us by the Greeks. To have good milk, the she-ass should be young, healthy, plump, and uncovered; the colt should be taken from her; she ought to be kept by herself, and fed with hay, oats, barley, and such salutary herbs as may have an influence on the malady. The milk should never be allowed to cool, nor even be exposed to the air, which injures it in a very short time.

As the skin of the ass is very hard and elastic, it is applied to many different uses. It is employed for making sieves, drums, shoes, and pocket-book parchment, which is laid over with a slight coat of plaster. The ass skin is likewise used by the eastern nations for making their sagri or chagrin. It is also probable, that the bones of the ass are harder than those of other animals, since the ancients preferred it for making their best sounding flutes.

In proportion to his size, the ass can carry more weight than any other animal. As he is fed at very little expence, and requires hardly any care, he is of great use for different kinds of country-business. He may likewise be used for riding: all his motions are soft, and he is not so apt to stumble as the horse. In countries where the land is light, he is often yoked in the plough; and his dung, in strong moist land, is an excellent manure.

THE OX.

THE generic characters are: the horns bend out laterally; there are eight cutting teeth in the lower jaw, and none in the upper; the skin along the lower side of the neck is pendulous. The specific marks of the common bull and cow are, rounded horns, with a large space between their basis.

The surface of the earth, adorned with its verdure, is the common and inexhaustible source, from which man and other animals derive their subsistence. Every animated being in nature is nourished by vegetables; and these, in their turn, are supported by the spoils of all that has lived or vegetated. Destruction is necessary to life: it is only by the destruction of beings, that animals can live and multiply. God, when he created the first individuals of each species of animal and vegetable, not only bestowed form on the dust of the earth, but gave it animation, by infusing into these individuals a greater or smaller quantity of active principles, of living organic particles, which are indestructible, and common to every organized being. These particles pass from body to body, and are equally the causes of life, of the continuation of the species, of growth, and of nutrition. After the dissolution of the body, after it is reduced to ashes, these organic particles, upon which death has no influence, survive, circulate through the universe, pass into other beings, and produce life and nourishment. Hence every production, every renovation or increase by means of generation, of nutrition, or of growth, implies a preceding destruction, a conversion of substance, a translation of organic particles, which never multiply, but uniformly subsisting in equal numbers, render Nature always equally animated, the earth equally peopled, and equally resplendent with the original glory of that Being by whom it was created.

Taking beings in general therefore, the total quantity of life remains always the same; and death, which seems to be an universal destroyer, annihilates no part of that primitive life which is common to all organized bodies. Like all subordinate powers, Death attacks individuals only. His blows are confined to the surface: he destroys the form, but has no influence on the matter. He is unable to injure Nature; his strokes, on the contrary, make her shine with additional lustre. She permits him not to annihilate the species, but allows him, successively, to mow down individuals, with a view to demonstrate her independence both of Death and of Time, to give her an opportunity of exerting at every instant, her power, which is always active, and of manifesting the extent of her resources by her fertility, and by a perpetual renovation of beings, to make the universe a theatre always filled with objects which attract our attention by their grandeur and novelty.

It is apparent therefore, that a succession of beings cannot otherwise be effected than by mutual destruction. For the nourishment and subsistence of animals, vegetables or other animals must be sacrificed: and as both before and after this destruction, the quantity of life remains always the same, Nature seems to be indifferent whether particular species be more or less consumed. Like an œconomical parent, however, in the midst of fulness and affluence, she fixes limits to her expence, and prevents any unnecessary waste, by bestowing on few animals the instinct of feeding on flesh, while she has multiplied profusely, both the species and the individuals of those which live upon plants. In the vegetable kingdom, she seems even to be prodigal of species, which are every where diffused, and endowed with an astonishing fecundity. Man, it is probable, has contributed not a little to promote the intentions of Nature, by maintaining, and even establishing, this order upon the earth; for in the ocean we actually perceive that indifference which we have supposed. Fishes of every kind are almost equally voracious. They live upon their own or different species, and perpetually devour each other, without annihilating any particular kind; because their fecundity is proportioned to the depredations they commit, and the whole consumption reverts to the advantage of reproduction.

Man knows how to exercise his power over animals. He selects those whose flesh is most agreeable to his palate, makes them his domestic slaves, and multiplies them far beyond what Nature would have done. By his industry in promoting their increase, he seems to have acquired a right to sacrifice them. But he extends this right farther than his necessities demand. He makes war against savage animals, birds, and fishes. He does not even limit himself to those of the climate he inhabits, but goes to foreign nations, and to the midst of the ocean, in quest of new luxuries. All Nature seems to be insufficient to satisfy the intemperance and caprice of his appetite. Man alone consumes more flesh than all the other carnivorous animals in the world. He is unquestionably the greatest destroyer; and he is so more from abuse than necessity. Instead of enjoying with

moderation the benefits presented to him, instead of dispensing them with equity, or making reparation in proportion to his waste, by renewing what he annihilates, the rich man places his chief glory in consuming at table more in one day than would be sufficient to feed many families. His abuse is not confined to the animals but extends to his fellow men, many of whom languish with famine and misery, and labour only to satiate the vanity and luxurious appetite of the opulent, who kill the poor by famine, and put an end to their own existence by excess.

Man, notwithstanding, like some other animals, might live upon vegetables. Flesh, which appears so analogous to flesh, affords not better nourishment than grain or bread. That nutriment which contributes to the expansion, growth, and support of the body, consists not of the inert and visible matter of which the texture of flesh and of herbs is composed, but of the organic particles contained in both these substances; for the ox, in browsing the herbage, acquires as much flesh as man and other animals who live entirely on carnage and blood. There is but little difference between these two kinds of aliment: when the quantities are equal, flesh, grain, and seeds, contain a greater number of organic particles than herbage, or the leaves, roots, and other parts of plants. Of this fact we are ascertained by examining infusions of these substances; so that man, and the other carnivorous animals, whose stomachs and intestines are not so capacious as to admit a great deal of aliment at a time, are unable to devour herbage in quantities sufficient to afford the number of organic particles necessary for nourishing them. It is for this reason that man, and the other animals who have but one stomach, can subsist only upon flesh and seeds, which contain in a small volume a great number of these organic nutritive particles: while the ox, and other ruminant animals, who have several stomachs, one of which is remarkably capacious, and consequently can admit a large quantity of herbage, are enabled to extract from this mass a number of organic particles sufficient for their nourishment, growth, and multiplication. Here the quantity compensates the quality of the nutriment. But the stock is the same. It is the same matter, the same oganic particles, which nourish man, the ox, and all other animals.

It will be objected, that the horse has but one stomach, and a very small one; that the ass, the hare, and other animals which live upon herbs, have likewise but one stomach; and consequently, that this theory, however specious, is not well founded. These apparent exceptions however, so far from weakening, seem to confirm the truth of it; for though the horse and the ass have but one stomach, they have sacs or pouches in their intestines so large that they may be compared to the paunch of ruminating animals; and hares have a blind gut so long and wide, that it is equivalent at least to a second stomach. Thus it is by no means surprising that these animals are properly nourished by herbage alone; and in general, it will always hold, that the different modes of feeding among animals depend on the total capacity of their stomach and intestines: for ruminating animals, as the ox, the sheep, the camel, &c. have four stomachs, and intestines of a prodigious length; and herbage alone is sufficient to nourish them. Horses, asses, hares, rabbits, guinea-pigs, &c. have one stomach only, but they have a blind gut equivalent to a second stomach; and they feed upon herbage and grain. The wild boar, the hedge-hog, the squirrel, &c. whose stomachs and intestines are of a mean capacity, eat little herbage, but live principally upon seeds, fruits, and roots: and those animals which, in proportion to the size of their bodies, have small stomachs and intestines, as the wolf, the fox, the tiger, &c. are obliged to choose food of the most succulent kind, and which contains the greatest number of organic particles, and of course to live upon flesh, blood, seeds, and fruits.

It is obvious, therefore, that the diversity of tastes perceived in the appetites of different animals, arises not from the superior agreeableness of particular kinds of food to their palates, but from a physical cause necessarily depending on the structure of their bodies: for if they were not oftener determined by necessity than by taste, how could they devour corrupted carrion with equal avidity as fresh and succulent flesh? Why should they eat, without distinction, every species of flesh? We see, that domestic dogs, who have the liberty of making a choice, constantly refuse certain meats, as pork, woodcocks, thrushes, &c. But wild dogs, wolves, foxes, &c. eat indiscriminately the flesh of swine, woodcocks, birds of every kind, and even frogs; for I once found two frogs in the stomach of a wolf. When they can procure neither flesh nor fish, they eat fruits, seeds, grapes, &c. But they uniformly prefer those kinds of food which, in a small volume, contain a great quantity of nutriment, or rather of organic particles, proper for nourishing and supporting their bodies.

If these proofs should not appear to be sufficiently strong, let us attend to the manner of feeding cattle, when the object is to fatten them. They are first castrated, which obstructs the passage through which the greatest quantity of organic particles escape. Then, instead of allowing them to feed as usual, on herbage alone, they are served with bran, corn, turnips, and in a word, with food more substantial than grass. The quantity of flesh, juices, and fat, soon augment; and from a flesh naturally hard and dry, good and succulent meat is produced, which is used as the basis of our best dishes.

From what has been advanced, it is likewise a consequence, that man, whose stomach and intestines are proportionally of no great capacity, could not live upon

herbage alone. It is an incontestible fact, however, that he can live pretty well upon bread, herbs, and the seeds of plants; for we know whole nations, and particular orders of men, who are prohibited by their religion from eating any animal substance. But these examples, though supported by the authority of Pythagoras, and recommended by some physicians, appear insufficient to convince us that the health and multiplication of mankind would be improved by feeding solely upon pot-herbs and bread; especially when it is considered, that the country people, whom the luxury and sumptuousness of the opulent reduce to this mode of living, languish and die much sooner than men of the middle rank of life, who are equally strangers to want and to excess.

Next to man the carnivorous animals are the greatest destroyers. They are at once the enemies of nature and the rivals of the human kind. A constant attention, joined to the most indefatigable industry, are necessary to protect our flocks, poultry, &c. from birds of prey, and from the rapacious jaws of the wolf, fox, weasel, martin, &c. A perpetual war is requisite to defend even our grain, fruits, and garments, against the voracious attacks of rats, caterpillars, beetles, mites, &c.; for insects are to be ranked among those animals which are more destructive than useful. But the ox, the sheep, and other herbivorous animals, are not only the most precious and the most useful to man, but they consume less, and are maintained at the smallest expence.

But these are not the only advantages which man derives from the ox. Without the aid of this useful animal, both the poor and the opulent would find great difficulty in procuring subsistence; the earth would remain uncultivated; our fields and gardens would become parched and barren. All the labour of the country depends upon him. He is the most advantageous domestic of the farmer. He is the very source and support of agriculture. Formerly the ox constituted the whole riches of mankind; and he is still the basis of the riches of nations, which subsist and flourish in proportion to the cultivation of their lands and the number of their cattle: for in these all real wealth consists; every other kind, even gold and silver, being only fictitious representations, have no value, but what is conferred on them by the productions of the earth.

The form of the ox's back and loins show that he is not equally qualified for carrying burdens as the horse, the ass, or the camel. But the thickness of his neck, and broadness of his shoulders, point him out as destined for the yoke. Though his chief strength lies in his shoulders, yet in many provinces of France they oblige him to draw by the horns. In support of this practice, it is alledged, that when yoked in this manner he is more easily managed. His head, I allow, is so very strong, that he may draw tolerably well by the horns; but he would draw with still much more advantage if yoked by the shoulders. Nature seems to have intended him for the plough. The largeness of his body, the slowness of his movements, the shortness of his legs, and even his tranquillity and patience under labour, concur in rendering him superior to every other animal for cultivating the ground, and overcoming that constant resistance which the earth opposes to his efforts. The horse, though perhaps equal in strength, is not so well fitted for this kind of labour. His limbs are too long, and his motions too sudden and violent. Besides, he is impatient and easily disheartened. When employed in this heavy work, which requires more perseverance than ardour, more force than quickness, and more weight than spring, we rob the horse of all the nimbleness of his motions, and all the graces of his gait and attitudes.

Of those animals which man forms into flocks, and whose multiplication is his principal object, the females are more useful than the males. The produce of the cow is almost perpetually renewed. The flesh of the calf is equally wholesome and delicate; the milk is an excellent food, especially for children; butter is used in most of our dishes; and cheese is the principal nourishment of our peasants. How many poor families are reduced to the necessity of living entirely on their cow? Those very men, who toil from morning to night, who groan and are bowed down with the labour of ploughing the ground, obtain nothing from the earth but black bread, and are obliged to yield to others the flour and the substantial part of the grain. They raise rich crops, but not for themselves. Those men who breed and multiply our cattle, who spend their whole lives in rearing and guarding them from injuries, are debarred from enjoying the fruits of their labour. They are denied the use of flesh, and obliged by their condition, or rather by the cruelty of the opulent, to live, like horses, upon barley, oats, coarse pot-herbs, &c.

The cow may likewise be used in ploughing, and though her strength is not equal to that of the ox, she frequently supplies his place. But when employed in this way, she should be matched as nearly as possible with an ox of the same stature and strength, or with another cow, in order to maintain the equality of the draught, and to keep the plough in equilibrium between the two forces, which facilitates the labour and makes the furrows more regular. From six to eight oxen are often employed in stiff land, and particularly in rough fallow-ground, which rise in large masses. But two cows are sufficient for light soils; and in very light land the length of the furrow drawn at once may be farther extended. The ancients limited the length in the furrow, to be drawn without any interruption in the motion of the cattle, to 120 paces; after which they were allowed to stop, for a few moments, to recover their breath, before going on with the same furrow, or beginning a new

one. But the ancients delighted in the study of agriculture, and gloried in ploughing themselves, or at least in encouraging their labourers, and rendering both them and the cattle as easy as possible. Among the moderns, however, those who enjoy the most luxurious productions of the earth, are least acquainted with the means of encouraging or supporting the arts of cultivation.

Propagation is the principal use of the bull. Though he may likewise be trained to labour; yet his obedience is uncertain, and it is always necessary to guard against the improper exertions of his strength. Nature has endowed the bull with a bold and untractable disposition. In the rutting season, he becomes perfectly ungovernable, and often furious. But castration, while it destroys the source of these impetuous emotions, diminishes not his strength. On the contrary, it makes him larger, heavier, and more fit for the labour to which he is destined. It also changes his dispositions; for after this operation, he becomes more tractable, more patient, and less troublesome to his neighbours. A flock of bulls would exhibit a scene of the most frightful discord; they could neither be intimidated nor conducted by man.

The manner of performing castration is well known to the country-people. Different modes, however, are practised, and their effects are perhaps not properly attended to. In general, the time most proper for castration, is that which immediately precedes puberty, which happens at the age of 18 months or two years. However, when young calves are castrated soon after birth, and survive an operation so dangerous at that period of life, they become larger and fatter oxen, than if it had been delayed till the second, third, or fourth year. But in the latter case, they preserve more of their natural activity and courage: and when delayed till the sixth, seventh, or eighth year, the animals hardly lose any of the qualities peculiar to the male sex. They are more impetuous and untractable than other oxen; and in the season of love, they are apt to harass the females, from whom they should be carefully separated.

The females generally come in season in the spring; and in France, most of them receive the bull and are impregnated from the 15th of April to the 15th of July; but some are earlier and others later. Their time of gestation is nine months; and they bring forth in the beginning of the tenth. Hence our calves are numerous from the 15th of January to the 15th of April. They are also plenty during the whole summer, and become more rare in autumn. The marks of ardour in the cow are not equivocal. She then lows more frequently and with more violence than at any other time. She mounts upon cows, oxen, and even upon the bull. The external parts swell, and become prominent. When her ardour is greatest, she ought to be gratified; for if allowed to abate, she is apt not to retain.

The bull, like the stallion, should be chosen from the handsomest of his kind. He should be large, well made, and in good condition with regard to fatness. His eyes should be black, his aspect bold, his front open, his head short, his horns thick, short, and black, his ears long and bushy, his muzzle large, his nose short and straight, his neck fleshy and thick, his chest and shoulders large, his loins firm, his back straight, his legs thick and fleshy, his tail long and well covered with hair, his tread firm and sure, and his hair of a reddish colour. Cows often hold at the first, second, or third time; and as soon as they are impregnated, though the symptoms of ardour still appear, the bull often refuses to cover them: but in in general, their ardour ceases immediately after conception, and they spontaneously repel the approaches of the bull.

Cows with young, when improperly managed, or put to the plough, carriage, &c. are subject to abortion; they should therefore be carefully watched and attended, to prevent them from leaping hedges or ditches. They should also be fed on rich pasture, and in parks which are not too moist or marshy. Six weeks or two months before bringing forth, their ordinary quantity of food should be enlarged, by putting grass into their stalls in summer, and in winter by giving them bran, lucern, saintfoine, &c. From this period no milk should be drawn from them, the whole of it being necessary for nourishing the fœtus. In some cows, the milk dries up entirely a month or six weeks before they bring forth; but those which have milk to the last, make the best mothers and the best nurses. This late milk, however, is commonly bad, and in small quantity. The delivery of the cow requires still more attention than that of the mare; for the former is weaker and more exhausted by the operation. She ought to be put into a stable, to have good litter, and to be fed, for ten or twelve days, with bean-flour, or oats, diluted in salted water, and plenty of lucern, saintfoine, or good grass. This time is generally sufficient for the recovery of her strength; after which she may gradually return to her usual mode of living and pasturing. During the first two months, her milk, which is then not good, should be solely appropriated to the nourishment of the calf.

That the calf may be kept warm, and suck as often as it chooses, it should be allowed to remain constantly with the mother for the first five or six days. After this period, the calf, if always left with the mother, would exhaust her by sucking too much. It is sufficient to let calves suck twice or thrice a-day; and to improve their flesh and fatten them quickly, they should every day be fed with raw eggs, boiled milk, and bread. At the end of four or five weeks, calves managed in this manner are fit for the butcher. When designed for the market, they may be allowed to suck only 30 or 40 days. But

those which are intended to be brought up, should have suck two months at least; for the longer they are allowed to suck, they become the larger and stronger cattle. Calves brought forth in the months of April, May, and June, are best for rearing; those that come later into the world, being unable to resist the rigour of winter, generally languish and die with cold. At the end of two, three, or four months, and before weaning them entirely, they should be fed with good grass or tender hay, to accustom them gradually to their future nourishment. They should then be separated from the mother, and never again be permitted to approach her either in the stable or the field. In summer, they should be pastured every day from morning to night. But as soon as the cold commences in autumn, they should be turned out to pasture late in the morning, and brought back to the stable early in the evening: and during winter, as cold is extremely hurtful to them, they should be kept warm in a close well littered stable. Along with their usual food, they should have saintfoine, lucern, &c. and never be allowed to go out except in soft weather. During the first winter, which is the most dangerous period of their existence, they require a great deal of attention. In the succeeding summer, they acquire strength sufficient to fortify them against the attacks of the second winter.

The cow arrives at the age of puberty in eighteen months, and the bull in two years. But though they are then capable of generating, they should not be admitted to each other till they be three years old. From three to nine years, these animals are in their greatest vigour. After this period, both cows and bulls are only fit for being fattened and delivered to the butcher. As they acquire their full growth in two years, the duration of their life, like that of most other animals, is nearly seven times two, or fourteen years; few of them ever exceed this age.

In all quadrupeds, without exception, the voice of the male is stronger and deeper than that of the female. Though the ancients alledge that the cow, the ox, and even the calf, have deeper voices than the bull; yet the contrary is certain; for the voice of the bull reaches much farther. The bellowing of the bull not being a simple sound, but composed of two or three octaves, the highest of which strikes the ear most forcibly, may have given rise to this deception: but when we listen attentively, we perceive at the same time, a sound much graver than is uttered by the cow, the ox, or the calf, whose lowings are also a great deal shorter. The bull never bellows, but when stimulated by love; the lowings of the cow proceed oftener from terror or timidity, than from any other cause; and pain, hunger, or the absence of the mother, produce the complaints of the calf.

The heaviest and most sluggish animals are not those which sleep longest or most profoundly. The slumbers of the ox are slight and short. The smallest noise rouses him. He lies commonly on the left side; and the left kidney is always larger and fatter than the right.

The ox, like other domestic animals, varies in colour. The reddish colour, however, is most common, and in highest estimation. Some praise the black colour; and others maintain that bay oxen live longest; that the brown soon decay and lose their spirit; and that the gray, the dappled, and the white, are of no value for the purposes of labour, and should only be fattened for slaughter. But whatever be the colour of an ox, his coat ought to be smooth, shining, thick, and soft to the touch; for when rough and unequal, it indicates bad health, or a weak constitution. A good ox for the plough should neither be too fat nor too lean; his head ought to be short, his ears large and well covered with hair, his horns strong, shining, and middle-sized, his forehead broad, his eyes large and black, his muzzle thick and flat, his neck fleshy and strong, his shoulders thick and massy, his chest large, his dewlap long, and extending as far as his knees, his loins very broad, his belly wide and prominent, his flanks large, his haunches long, his crupper thick, his legs and thighs large and nervous, his back straight and plump, his tail as long as to reach the ground, and covered with fine bushy hair, his feet firm, his skin thick and pliable, his muscles well raised, and his toes or hoofs broad and short. He should likewise feel the goad with sensibility, obey the call of his driver, and be well trained. But it is only by degrees, and by beginning at an early period, that the ox can be taught patiently to bear the yoke, and to allow himself to be conducted with ease. At the age of two and a half, or three years at most, we should begin to tame him, and to accustom him to the yoke. If longer delayed, he often becomes perfectly ungovernable. Patience, mildness, and even caresses, are the only means which should be employed. Force and harsh treatment serve no other purpose than to dispirit and render him totally unmanageable. He should be stroaked and caressed; and he should occasionally be fed with boiled barley, bruised beans, and other aliments of the same kind, mixed with a little salt, of all which he is extremely fond. His horns, at the same time, should be frequently tied. Some days afterwards, he may be yoked to the plough along with another ox of the same stature, which has been previously trained. They should be tied up together at the manger, and led to the same pasture, in order to make them thoroughly acquainted, and acquire the habit of having always the same movements. At first the goad should never be used; for it contributes to render them untractable. They should be forced to work only a little at a time; for when not thoroughly broke, they are soon fatigued. For the

same reason they should be fed more plentifully than usual.

The ox ought to labour only from three to ten years; for when he works till he be farther advanced, the quality of the beef is injured. The age of this animal is known by his teeth and horns. The middlemost foreteeth fall out when he is ten months old, and are replaced by others which are broader but not so white. At the age of sixteen months, those next to the former shed, and are succeeded by others. At the age of four years, the whole cutting teeth are renewed; and they are then even, long, and pretty white. In proportion as the ox advances in years, these teeth wear and become black and unequal. The same thing happens to the bull and cow. Thus neither sex nor castration have any influence on the growth or shedding of the teeth. Neither do these circumstances produce any alteration in the casting of the horns; for at the age of three years the bull, cow, and ox, shed their horns, which are replaced by others, and which, like the second teeth, never fall off. The horns of the ox and cow are longer and thinner than those of the bull. The growth of the second horns is not uniform. The first year, which is the fourth of the animal's growth, two neat pointed horns, terminated near the head by a kind of ring, arise. In the following year this ring mounts farther from the head, being pushed forward by a new horny cylinder, which is likewise terminated by another ring, and so on; for the horns continue to grow as long as the animal lives. These rings are very apparent; and by their number the ox's age may be easily counted, by adding three years to the number of interval's between the rings.

The horse eats slowly, but almost perpetually. The ox, on the contrary, eats fast, and fills his stomach in a very short time; after which, he lies down to ruminate. This difference in eating proceeds from the different conformation of their stomachs. The ox, whose two first stomachs consist of but one large bag, can without inconveniency, quickly throw in a great quantity of herbage, which, by means of chewing the cud, he digests at leisure. But the stomach of the horse, which is single and small, can only receive a small quantity of food; and he therefore fills it gradually, in proportion as the herbage dissolves and passes into the intestines, where the decomposition of the aliment is chiefly effected. Having examined in the ox and horse, the successive product of digestion, particularly in the decomposition of hay, I remarked in the ox, that when the aliment was passing into that part of the paunch which forms the second stomach, it was reduced to a kind of green paste, resembling boiled spinage; that under this form it is retained in the folds of the third stomach; that the decomposition is completed in the fourth stomach; and that hardly any thing passes into the intestines except fæces or dregs. But in the horse the hay is not decomposed, either in the stomach or first portions of the intestines, where it only becomes more soft and pliable, being macerated by the liquor by which it is surrounded. With very little alteration it arrives at the cæcum and colon. It is chiefly in these two intestines, whose extraordinary capacity corresponds with that of the paunch of ruminating animals, that the food of horses is decomposed. But the decomposition is never so complete as that which is effected in the fourth stomach of the ox.

For these reasons, and even from inspecting the parts, it is easy to conceive how rumination is performed, and why the horse neither ruminates nor vomits. Rumination is only a vomiting without much effort, occasioned by the re-action of the first stomach upon its contents. The ox completely fills his two first stomachs or portions of the paunch. This membrane, when distended, re-acts with great force on the food it contains, which is very little cut by chewing, and whose volume is greatly augmented by fermentation. If the aliment were liquid, this contracting force would make it pass into the third stomach, which communicates with the other by a narrow canal whose orifice is situated in the superior part of the first, and nearly as high as that of the gullet. Hence this canal can only admit the food, after it is reduced to a more fluid form. The drier parts must therefore rise into the gullet, the orifice of which exceeds that of the canal. When the food comes back into the mouth, the animal chews it again, and macerates it with a fresh quantity of saliva, which gradually liquifies it to such a degree as enables it to pass through the canal into the third stomach, where it is still farther diluted before it enters the fourth. It is in this last stomach, that the hay, which is there reduced to a perfect mucilage, is completely decomposed. To confirm the truth of this explanation, it may be remarked, that as long as these animals suck, or are nourished with milk, and other liquid aliments, they never ruminate; and that, in winter, when they are fed with dry aliment, they ruminate much oftener than during summer when the grass is tender and succulent. The stomach of the horse, on the contrary, is small; the orifice of the œsophagus is narrow, and that of the pylorus very large. These circumstances alone render rumination impracticable; for the food contained in this small stomach, though perhaps it suffers a greater compression than from the stomach of the ox, cannot mount upwards; because it descends with greater ease through the pylorus, which is much wider than the gullet. To pass through the pylorus it is not even necessary that the hay be reduced to a soft mash; for the contracting force of the stomach is capable of pushing it through when almost dry. This difference of structure therefore enables the ox to ruminate, and prevents the horse from performing that function.

But there is another singularity in the horse, which absolutely prevents him from vomiting, and consequently from chewing the cud. The alimentary canal, by coming in a very winding direction into the stomach, the coats of which are exceedingly thick, makes a gutter in piercing them so oblique, that instead of being opened by the convulsive motions of the stomach, they only serve to shut it the closer. Though this, as well as other differences of structure observable in the bodies of these two animals, are derived from nature, because they are invariably the same, yet in the developement of the soft parts particularly there are differences apparently constant, which nevertheless may, and often are varied by particular circumstances. The great capacity of the ox's paunch, for example, is not solely a production of nature. Its original conformation, on the contrary, is varied, and its capacity gradually enlarged, by the fermentation and great volume of the aliments it receives: for in a calf that has never eat grass, though not very young, the paunch is proportionally much less than in the adult. Hence this uncommon capaciousness of the paunch proceeds from the extension occasioned by the great mass of aliment daily devoured. Of this I was convinced by an experiment which appears to be decisive. I fed two lambs of equal ages, and weaned, at the same time, the one with bread and the other with grass. At the end of twelve months, when both were opened, I found that the paunch of the latter was much larger than that of the former.

It is alledged, that oxen which eat slowly support labour longer than those that eat quickly; that the oxen of dry and elevated countries are more active, vigorous, and healthful, than those which are fed in low moist grounds; that they are stronger when fed with dry hay than with soft grass; that they are more difficultly habituated to a change of climate than horses; and for this reason, that oxen designed for labour ought never to be brought from any great distance.

The oxen in the labouring season should have more hay than straw, and even a little bran or oats. In winter, if the hay be scarce, they should be fed with cut grass, or rather with the young shoots and leaves of the ash, elm, oak, &c. But of these last they should be allowed small quantities only; because indulgence in this kind of food, of which they are exceedingly fond, sometimes occasions a bloody urine. Lucerne, saintfoine, vetches, whether green or dry, lupins, turnips, boiled barley, &c. afford them excellent nourishment; and as they never use more than is necessary, they should always have as much as they will take. They should not be permitted to pasture till the middle of May; because young herbage is too crude for them; and though they eat it with avidity, it sometimes makes them uneasy. They should be pastured during the whole summer, and about the middle of October they should be brought back to the stall, always taking care not to make their changes from green food to dry, or from dry to green, too rapid, but to accustom them gradually to these different kinds of aliment

Great heat is perhaps more hurtful to these animals than great cold. During summer, they should be set to work very early in the morning, put into the stable, or left to graze under the shade of trees in the middle of the day, and not yoked again till three or four o'clock in the afternoon. In spring, autumn, and winter, they may be wrought without interruption from eight or nine in the morning to five or six in the evening. Though they require not so much attention as the horse, yet to keep them vigorous and healthful they should be daily curried and washed; their hoofs should likewise be rubbed over with grease. They should also have drink, at least twice a-day. Though the horse loves muddy and lukewarm water, the ox always prefers that which is fresh and clean.

Though the cow in general requires the same food and management as the ox; yet the milk-cow demands particular attention, both in the choice and treatment of her. It is said, that black cows give the best milk; and that white cows furnish the greatest quantity of milk. But whatever be the colour of a milk-cow, she ought to be plump, to have lively eyes, and a lightness in her motions. She should likewise be young, and give plenty of good milk. In summer she should be milked twice a-day, and only once in winter; and when an increase in the quantity of milk is required, she ought to have more succulent food than herbage.

Good milk is neither too thick nor too thin. Its consistence should be such, that a small drop ought to preserve its spherical figure without running. It should also be very white; when of a yellowish or blueish colour, it is of no value. Its taste should be sweet, without any degree of bitterness or sharpness. Its flavour should be agreeable. In the month of May, and during the summer, milk is better than in winter; and it is never perfectly good but when the cow is of a proper age and in good health. The milk of young heifers is too thin, and that of old cows is too thick, especially in winter. These different qualities of milk are proportioned to the quantities of oily, caseous, and serous particles it contains. Thin milk has too great a quantity of serous particles; too thick milk has the opposite quality; and milk that is too dry has not enough of the oily and serous particles. The milk of a cow in season, or when near the end of gestation, or soon after delivery, is bad. In the third and fourth stomachs of a sucking calf there are clots of curdled milk, which, after being dried in the air, become runnet, or that well known substance which coagulates milk. The longer the runnet is kept, its strength increases, and a small quantity of it is sufficient to make a great deal of cheese.

Both cows and oxen are fond of wine, vinegar, and salt; and they devour a dressed sallad with great avidity. In Spain, and some other countries, one of those salt-stones, called salegres, and which are found in the salt-mines, are placed near the young calves in the stable. They lick this stone during the time their mothers are pasturing, which excites their appetite, or creates thirst to such a degree, that when the mothers return, the calves suck greedily, and by this means they grow and fatten much sooner than those to whom no salt is given. For the same reason, when oxen lose their appetite, they are served with grass drenched in vinegar, or sprinkled with salt. To make them fatten quickly, salt, as it increases their appetite, may also be administered. It is common to begin to fatten them at the age of ten years. If longer delayed, success is not so certain, neither is their flesh equally good. They may be fattened in all seasons; but summer is preferable, because less expence is incurred; and by beginning in May or June, they are fit for the butcher before the end of October. Whenever we begin to fatten oxen, they should no longer be allowed to labour. They ought to drink frequently, to have plenty of succulent food, sometimes mixed with a little salt; and they should be permitted to ruminate and sleep in the stable during the heat of the day. By this treatment, in four of five months, they will be so fat as to be hardly able to walk, or be conducted to any distance but by very short journeys. Cows, and even bulls whose testicles have been twisted, may also be fattened. But the flesh of the cow is drier than that of the ox; and the flesh of the bull, even when maimed, is red, hard, and has a strong disagreeable taste.

Bulls, cows, and oxen, are fond of licking themselves, especially when lying at their ease. To prevent this practice, which is supposed to retard their fattening, it is common to besmear every part of the body they can reach with their own dung. If this precaution be neglected, they swallow great quantities of hair, which being an indigestible substance, remains in the stomach, and forms a kind of ball, of a size so considerable as to hurt the powers of digestion. These balls, in process of time, are covered with a brown crust, which, though formed of mucilage, becomes hard and polished. They are only found in the maw; and if any hairs enter into the other stomachs, or bowels, they are probably discharged along with the fæces.

Animals which, like the horse and ass have cutting teeth in both jaws, browse short grass with more ease than those that want these teeth in the upper jaw. The sheep and goat indeed cut very close, because they are small animals, and have thin lips. But the ox, whose lips are thick, can eat long grass only. It is for this reason that he does no injury to the pasture on which he feeds. As he only bites off the extremities of young herbage, the roots are not disturbed, and the growth is very little retarded. The sheep and goat, on the contrary, cut the plants so close to the ground, that the stems are destroyed and the roots spoiled. Besides, the horse always selects the shortest and most tender, allowing that which is longer and harder to ripen and shed the seeds. But the ox devours all the large stems, and gradually destroys the coarser kinds of grass. Hence, in a few years, grass pastured by the horse degenerates, while the ox always improves the herbage on which he feeds.

The domestic ox, which ought not to be confounded with the urus, the buffalo, or the bison, seems to be a native of our temperate climates, excessive heat or excessive cold being equally hurtful to him.' Besides, this species, so abundantly diffused over all Europe, is not found in the equatorial regions, and extends not in Asia, beyond Armenia and Persia, nor in Africa, beyond Egypt and Barbary: for in India, the southern parts of Africa, and even America, their native cattle are either bisons, which have a protuberance on their backs, or other animals of a different species, to whom travellers have given the name of oxen. Those found at the Cape of Good Hope, and in many parts of America, were transported thither from Europe by the Dutch and Spaniards. In general, countries which are somewhat cold, seem to be more agreeable to our oxen than warm climates. They are likewise larger and taller in proportion to the moistness of the climate, and the richness of the pasture. The largest oxen are those of Denmark, Podolia, the Ukraine, and Calmuck Tartary. Those of Britain, Ireland, Holland, and Hungary, are larger than those of Persia, Turkey, Greece, Italy, France, and Spain; and the Barbary oxen are the most diminutive. The Dutch, I am assured, bring annually from Denmark a great number of large meagre cows, which give more milk than those of France. The milch cows, called Lath-backs, which are numerous in Poitou, Aunis, and the fens of Charpente, have probably been derived from this race; for they are larger, leaner, and yield more milk and butter than the common kind. They may be milked during the whole year, except four or five days before they bring forth; but they require excellent pasture. Though they eat no more than ordinary cows, as they continue always meagre, all their superfluous nourishment is converted into milk. But whenever ordinary cows feed for some time in rich pastures, they become fat, and cease to give milk. With a bull of this race, and common cows, a bastard kind is produced, which is more fertile in milk than the ordinary race. This bastard race frequently bring forth two calves at a birth, and likewise give milk during the whole year. Cows form a part of the riches of Holland, from which considerable quantities of butter and cheese are annually exported. The Dutch cows give twice as much milk as the French cows, and six times more than those of Barbary.

In Ireland, Britain, Holland, Switzerland, and other northern countries, great quantities of beef are salted and smoked, both for the purposes of trade, and for the use of the navy. These countries also export a prodigious number of hides. The skin of the ox, and even of the calf, are used for many purposes. The grease is likewise a substance of great utility. The dung of the ox is the best manure for dry and light soils. The horn of this animal afforded to men the first instrument for drinking, for augmenting sounds, for introducing light into houses, and for making lanthorns. It is now moulded into boxes, combs, spoons, and other articles of manufacture. But I must conclude; for natural history ends where the history of arts commences.

SUPPLEMENT

In Tartary and Siberia, the oxen are extremely numerous. At Tobolski there are also vast quantities of black cattle. I formerly mentioned, that in Ireland, both the oxen and cows frequently want horns: but this happens only in the southern parts of the island, and in some maritime places, where the grass is either scarce, or of a bad quality; which is an additional proof, that the horns are produced by redundant nourishment. In places adjacent to the sea, the Irish feed their cows with fish boiled into a kind of pap; these animals are not only accustomed to this kind of food, but they are very fond of it; and it is said, their milk is not affected with any disagreeable smell or taste.

The cows and oxen of Norway are in general very small. In the islands along the Norwegian coast, they are somewhat larger. This difference must proceed from better pasture, and from their being allowed in these islands to live without restraint; for they are left at absolute liberty, with no other guides than being accompanied in winter with a few rams, which are accustomed to scrape the snow from the ground, and to uncover the grass both for themselves and the other cattle. Here they often become so ferocious, that they can be taken by means of ropes only. These half-wild cows give very little milk. When pasture is scarce, they eat sea-weeds, mixed with boiled fish.

The European cattle have multiplied so prodigiously in South America, that at Buenos Ayres, and some degrees beyond it, no man thinks of appropriating them. The hunters kill thousands of them solely for the sake of their hides and tallow. They are hunted on horseback, and their pursuers either ham-string them, or take them in toils made of strong leather straps. In the island of Saint Catharine, upon the coast of Brazil, there are a few small oxen whose flesh is flabby and disagreeable to the taste. Both these defects are occasioned by bad nourishment; for as they have little pasture, they are chiefly fed upon wild gourds.

In some countries of Africa, oxen are very numerous. Between Cape Blanc and Sierra-Leona, the woods and mountains are covered with wild cows, which are generally of a brown colour, with sharp black horns. They multiply so fast, that if they were not perpetually hunted, both by Europeans and Negroes, their number would be infinite. In the provinces of Duguela, and Tremecen, and other parts of Barbary, as well as in the deserts of Numidia, there are wild cows of a dark chesnut colour. They are very small, but nimble, and they go in flocks, sometimes to the number of two hundred.

THE SHEEP.

THE horns of the common sheep are twisted spirally and pointed outwards: there are eight cutting teeth in the lower jaw, and none in the upper; and the hoofs are cloven.

That all domestic animals originally existed in a wild or savage state seems to be an incontestible fact. The history of those already given furnishes ample proof of this position; for we still find horses, asses, and bulls, living totally independent of the human race. Can man, who has subjected so many millions of individuals, boast of having conquered and enslaved an entire species? As all animals were created without his aid, is it not reasonable to suppose, that nature bestowed on them the faculty of existing and of multiplying without his assistance? If however we attend to the weakness and stupidity of the sheep; if we consider that this helpless animal is even unable to save himself by flight; that all the carnivorous animals are not only his mortal enemies, but prefer him to every other prey; that the species are not very fertile; that the life of individuals is short, &c. we should be tempted to think that the sheep was originally committed to the protection and guardianship of man, and that, without his aid this animal could neither subsist nor multiply, especially as no wild sheep have ever been found in the deserts. Wherever man has not the dominion, the lion, the tiger, and the wolf reign by the laws of force and of cruelty. These sanguinary and rapacious animals live longer and multiply faster than the sheep. In a word, if our flocks, which are now so prodigiously numerous, were still abandoned, the number and voracity of their enemies would soon annihilate the species.

It is therefore probable, that without the assistance of man the sheep could never have subsisted, or continued its species in a wild state. The female is absolutely devoid of every art, and of every mean of defence. The arms of the ram are feeble and awkward. His courage is only a kind of petulance, which is useless to himself, incommodious to his neighbours, and is totally destroyed by castration. The wedder is still more timid than the sheep. It is fear alone that makes sheep so frequently assemble in troops: upon the smallest unusual noise, they run close together; and these alarms are always accompanied with the greatest stupidity. They know not how to fly from danger, and seem not even to be conscious of the hazard and inconvenience of their situation. Wherever they are, there they remain obstinately fixed; and neither rain nor snow can make them quit their station. To force them to move, or to change their route, they must be provided with a chief, who is taught to begin the march; the motions of this chief are followed, step by step, by the rest of the flock. But the chief himself would also continue immoveable, if he were not pushed off by the shepherd, or by his dog, an animal which perpetually watches over their safety, which defends, directs, separates, assembles, and in a word, communicates to them every movement necessary to their preservation.

Of all quadrupeds, therefore, sheep are the most stupid, and derive the smallest resources from instinct. The goat, who so greatly resembles the sheep in other respects, is endowed with much more sagacity. He knows how to conduct himself on every emergency: he avoids danger with dexterity, and is easily reconciled to new objects. But the sheep knows neither how to fly nor to attack: however imminent her danger, she comes not to man for assistance so willingly as the goat; and to complete the picture of timidity and want of sentiment, she allows her lamb to be carried off, without attempting to defend it, or showing any marks of resentment. Her grief is not even expressed by any cry different from that of ordinary bleating.

But this animal, so contemptible in itself, and so devoid of every mental quality, is of all others the most extensively useful to man. From the sheep we are at once supplied both with food and clothing, without mentioning the particular advantages derived from the milk, the fat, the skin, the bowels, the bones, and the dung. To this animal nature seems to have given nothing that redounds not to the immediate advantage and convenience of man.

Love, which in animals is the most active and most general sensation, seems to be the only one that communicates vivacity to the ram. When under the influence of this passion, he becomes petulent, fights, and sometimes even attacks the shepherd. But the ewe, though in season, discovers not the smallest emotion: her instinct extends no farther than not to refuse the approaches of the male, to choose her food, and to distinguish her own offspring from those of the rest of the flock. The perfection, or certainty of instinct, always augments in proportion to the mechanism or innateness of the cause by which it is produced. A young lamb, in the midst of the most numerous flocks, searches for,

and discovers its mother, without ever once committing a mistake. It has been alledged, that sheep are susceptible of the pleasures of music; that they feed with more appetite, have better health, and fatten sooner by the sound of the pipe. But the remark is more probable, that music serves only to amuse the shepherd, and that the origin of the art was derived from this solitary and inactive kind of life.

These animals, so simple and dull in their intellect, are likewise very feeble in their constitution. They cannot continue long in motion: travelling weakens and extenuates them. When they run, they pant, and soon lose their breath. The ardour of the sun is equally incommodious to them as moisture, frost, and snow. They are subject to many diseases, most of which are contagious.

When the ewe is about to bring forth, she should be separated from the rest of the flock, and watched, in order to be ready to assist her in delivery. The lamb frequently presents crossways, or by the feet. In such cases, if not assisted, the mother's life is in great danger. When she is delivered, the lamb should be raised on its feet, and the milk should be drawn from the paps of the mother. As this first milk is bad, and would be hurtful to the lamb, it should not be permitted to suck till a fresh stock has accumulated. The lamb is kept warm, and shut up for three or four days with the mother, that it may learn to know her. To recover the strength of the ewe, she should be fed for some time with good hay, grinded barley, or bran mixed with a little salt. Her water should be lukewarm, and whitened with the flour of wheat, beans, or millet. At the end of four or five days, she may be allowed to return by degrees to her ordinary mode of living, and to pasture among her neighbours; but to prevent the milk being chaffed, she should not be conducted to any great distance. Some time after, when the lamb has acquired strength, and begins to frisk about, it may be allowed to follow its mother to the fields.

All the lambs which have the appearance of feebleness are generally sent to the butcher; and those only are kept which are most vigorous, largest, and best covered with wool. Lambs of the first litter are never so good as those of succeeding litters. When we want to rear lambs which are brought forth in the months of October, November, December, January, or February, they are kept in the stable, and only allowed to go out to suck every morning and evening till the beginning of April. Some time before this last period they are fed with a little grass every day, to accustom them to their new species of nourishment. They may be weaned when a month old; but it is better to suckle them six weeks or two months. White lambs are always preferred to those which are black or spotted; because white wool gives a higher price than that of any other colour.

In the temperate weather of spring or autumn, the lambs may be castrated at the age of five or six months, or even a little later. There are two methods of performing this operation. The testicles are either removed by incision, or the vessels which terminate in them are destroyed by a strait ligature. Castration renders lambs sick and melancholy. To prevent the disgust which succeeds, they should have bran mixed with salt for two or three days.

At the age of twelve months, rams, ewes, and wedders, lose the two fore-teeth of the under jaw: six months after, the two neighbouring teeth likewise fall out; and at three years of age they are all replaced, and are then equal and pretty white. But in proportion as the animal increases in years, the teeth begin to lose their enamel, and become blunt, unequal, and black. The age of the ram may be known by his horns, which appear the first year, and often at birth, and have a fresh ring added to them every year that he lives. Ewes seldom have any horns; but in place of them they have two bony protuberances. Some ewes, however, have two, and even four horns. These ewes are every way similar to the common kind; and their horns are from five to six inches long, and less twisted than those of the ram. When ewes have four horns, the two anterior ones are shorter than the other two. The ram is capable of generating in 18 months, and the ewe can produce when a year old. But it is better to prevent all communication between them till the ewe be two years of age, and the ram three. The young produced at more early periods, and even the first productions of these animals, are always feeble and ill-conditioned. One ram is more than sufficient to serve 25 or 30 ewes. The ram should always be selected from the strongest and most handsome of his species. He should be garnished with horns; for hornless rams, of which there are some in our climates, are less vigorous and less proper for propagating. A good and beautiful ram should have a strong thick head, a wide front, large black eyes, a flat nose, big ears, a thick neck, a long high body, a large crupper and reins, massy testicles, and a long tail. The best rams for breeding are those which are of a white colour, well covered with wool upon the belly, the tail, the head, the ears, and as far as the eyes. Ewes, whose wool is most abundant, most bushy, largest, most silky, and whitest, are always to be preferred, especially, if at the same time, they are large, have thick necks, and walk nimbly. It has also been remarked, that those which are rather meagre than fat are the best breeders.

The season of ewes is from the beginning of November to the end of April. However, when nourished with stimulating food, as bread made of hemp-seed, and salted water, they conceive at any time. Ewes are allowed to be covered three or four times; after which they are separated from the rams, who prefer the aged

ewes, and despise those that are younger. During the rutting season, ewes should not be exposed to rainy or stormy weather; for moisture prevents conception, and a clap of thunder often produces an abortion. A day or two after copulating they are allowed to return to their ordinary mode of living; for if the use of salted water, hemp-seed-bread, and other stimulating food, were continued, they would infallibly miscarry. They carry five months, and bring forth in the beginning of the sixth. They generally produce one lamb, but sometimes two. In warm climates they can produce twice a-year; but in France, and in colder climates, only once. To have lambs in the month of January, the ram is admitted to the ewes towards the end of July, or beginning of August. Those which are covered in September, October, and November, produce in February, March, and April. We may also have plenty of lambs in May, June, July, August, and September; and they only become rare in October, November, and December. The ewes give milk abundantly for seven or eight months. This milk affords pretty good nourishment to children and country-people. It makes very good cheese, especially when mixed with cow-milk. The time of milking ewes is immediately before they go out to the field, or soon after their return. In summer they may be twice milked every day, and once in winter.

Ewes when with young, grow fat; because they then eat more than at any other period. As they frequently hurt themselves and miscarry, they sometimes become barren, and some of them produce monsters. However, when properly managed, they bring forth during life, *i. e.* for ten or twelve years; but they are generally old and useless at the age of seven or eight years. The ram, who lives twelve or fourteen years, becomes unfit for propagating when eight years old. He should then be castrated, and fattened along with the old ewes. The flesh of the ram, even after being castrated and fattened, has always a disagreeable taste: that of the ewe is flabby and insipid. But the flesh of the wedder furnishes the most succulent and best of all our common dishes.

When men want to form a flock with a view to profit, they purchase ewes and wedders at the age of eighteen months, or two years, and a hundred of these might be managed by a single shepherd. If vigilant, and aided by a good dog, he will lose very few of them. When conducting them to the fields, he ought to go before, accustom them to the sound of his voice, and to follow him without stopping, or going aside among the corn, or the vines, where they commit great devastation. The sea-coasts, or plains on the tops of hills, afford them the best pasture. But low, moist, and marshy grounds, should always be avoided. During winter, they are fed in the stable, with bran, turnip, hay, straw, lucern, saintfoine, ash and elm leaves, &c. When the weather is not very bad, they should be allowed, chiefly for the sake of exercise, to go out every day. In this cold season, they are not led to the fields before ten in the morning, where they remain for four or five hours; after which they are made to drink, and are conducted back about three o'clock after noon. In spring and autumn, on the contrary, they are led out as soon as the sun has dissipated the moisture, or hoar-frost, and are not brought back till sun-set. In these two seasons, it is sufficient to make them drink once a-day, and immediately before they return to the stable, where they must always have forage, but in smaller quantity than during winter. It is only in summer that they ought to feed entirely in the fields, where they are conducted twice a-day, and also made to drink twice. They are brought out at day-break, allowed to feed four or five hours, and after drinking are led back to the fold, or some other shady place. About three or four o'clock after noon, when the excessive heat begins to diminish, they are again pastured till night comes on. Were it not for the ravages of the wolf, they ought to remain in the field during the whole night, as is practised in Britain, which would make them both more vigorous and more healthful. As the rays of the sun, when very warm, are apt to affect these animals with a vertigo, they should always be pastured with their heads turned from the sun, so that the body may form a kind of shade to defend the head. Lastly, to preserve their wool, they should not be allowed to feed among thorns, briars, thistles, &c.

In dry elevated grounds, where the wild thime and other odoriferous plants abound, the flesh of the sheep is of a better quality, than when fed in low moist plains. But sandy downs on the sea-coast produce the best mutton, because the herbage is saltish; and nothing improves the relish of mutton so much as pasture of this kind: besides, it gives an agreeable savour to the milk of the ewe, and increases its quantity. These animals are extremely fond of salt, and when given in moderate quantities, it is very salutary. In some places, a bag of salt, or a salt-stone, is put into the fold, which the creatures lick alternately.

Every year, those which begin to grow old, should be separated from the flock, for the purpose of fattening, because then a different management is necessary: if in summer, they should be conducted to the field before sun-rising, that they may feed upon grass moistened with dew. Nothing contributes more to fatten wedders than water taken in great quantities; and nothing retards their fattening more than the heat of the sun. For this reason, they should be put into the fold or shade at eight or nine o'clock in the morning, before the heat becomes too violent; and they ought to have a little

salt, in order to excite their appetite for water. They should be led out a second time, about four o'clock afternoon, to fresh and moist pastures. By this treatment, they acquire in two or three months, all the appearances of being fleshy and fat. But this fat, which originates from the great quantities of water drunk by the animal, is only a kind of pursy swelling, and would soon occasion the rot, if not prevented by killing them immediately after they acquire this fallacious appearance. Even their flesh, instead of being firm and juicy, is frequently very loose and insipid. To produce good mutton, beside the treatment above recommended, the animals should have better nourishment than grass. In winter, and indeed in all seasons, they may be fattened by keeping them in stables, and feeding them with the flour of barley, oats, wheat, beans, &c. mixed with salt, to increase their appetite for drink. But whatever mode be followed, it should be executed as quickly as possible; for they cannot be fattened a second time, most of them dying of diseases in the liver.

Worms are frequently found in the livers of animals: a description of those of the wedder and ox may be seen in the Journal des Scavans, and in the German Ephimerides. It was formerly imagined, that these worms were peculiar to ruminating animals: but M. Daubenton discovered the same species in the liver of the ass; and it is probable they exist in several other quadrupeds. Butterflies, it has likewise been said, are sometimes found in the liver of the wedder. M. Rouillé communicated to me a letter from M. Gachet de Beausort, physician at Montiers, of which the following is an extract: 'It is an old remark, that our Alpine wedders, which are 'the best in Europe, sometimes suddenly lose their flesh; 'that their eyes turn white and gummy; that their blood 'grows serous, having hardly any red globules; that 'their tongues are parched; and that their noses are 'stuffed with a yellow purulent mucus: though the 'creatures continue to eat plentifully, these symptoms 'are accompanied with extreme debility, and at last ter'minate in death. From repeated dissections, it has 'been discovered, that the animals had always butterflies 'in their livers. These butterflies were white, and fur'nished with wings; and their heads were nearly oval, 'hairy, and about the size of those of the silk-worm fly. 'Above seventy, which I squeezed out of the two lobes, 'convinced me of the truth of this fact. The convex 'part of the liver was also in a mangled condition. The 'butterflies are found in the veins only, and never in the 'arteries. Small butterflies, and likewise small worms, 'have been discovered in the cystic duct. The vena 'portarum and capsala glissonii were so soft, as to yield 'to the slightest touch. The lungs, and other viscera, 'were sound,' &c. If Dr. Gachet de Beausort had been more particular in his description of these butterflies, he might, perhaps, have removed the suspicion, that the animals he saw were only the common worms found in the liver of the sheep, which are very flat, broad, and of a figure so singular, as to appear at first sight, to be rather leaves than worms.

The wool of the sheep is shorn every year. In warm countries, where no danger arises from making the animal quite bare, they do not sheer the wool, but tear it off; and this operation is performed twice a-year. But in France, and in colder climates, the fleece is shorn only once a-year, and a part of it is allowed to remain, in order to protect the animal from the inclemency of the weather. The operation is performed in the month of May, after washing the sheep, to render the wool as clean as possible. The month of April is too cold; and if delayed till June or July, the wool does not grow sufficiently long to protect the animal from the cold of winter. The wool of the wedder is generally better, and in greater quantity, than that of the ewe or ram. The wool upon the neck, and about the top of the back, is of a better quality than that upon the thighs, the tail, the belly, &c. and that taken from dead or deceased animals is the worst. White wool is preferred to gray, brown, or black, because it is capable of being dyed any colour; and smooth sleek wool is better than that which is curled. It is even alledged, that wedders, whose wool is curled, are not so good as the others.

Land may be much improved by folding sheep: for this purpose a piece of ground is inclosed, and the flock shut up in it every night during the summer-season. The dung, urine, and heat of the animals, soon meliorate exhausted, cold, or barren grounds. A hundred sheep, in one summer, will fertilize eight acres of land for six years.

It has been remarked by the ancients, that all ruminating animals have suet: but this remark, strictly speaking, holds only with regard to the sheep and goat: the suet of the wedder is more copious, whiter, drier, firmer, and better than that of any other animal. Fat or grease is very different from suet, the former being always soft, while the latter hardens in cooling. The greatest quantity of suet is found about the kidneys; and the left kidney furnishes more than the right. There are also considerable quantities in the epiploon or web, and about the intestines; but it is not near so firm or good as that of the kidneys, the tail, and other parts of the body. Wedders have no other grease but suet; and this matter is so prevalent in their bodies, that their whole flesh is covered with it. Even the blood contains a considerable quantity of suet; and the semen is so charged with it, as to give that liquor a different appearance from that of other animals. The semen of men, of the dog, horse, ass, and probably of every animal which affords not suet, dissolves with cold; or when exposed to the air, becomes more and more fluid from the moment it escapes from the body. But the semen

of the ram, and perhaps of every animal that has suet, hardens and loses its fluidity with its heat. I remarked this difference when examining these liquors with the microscope: that of the ram fixes a few seconds after coming from the body; and in order to discover the living organic particles, of which it contains prodigious numbers, its fluidity must be preserved by the application of heat.

In the sheep, the taste of the flesh, the fineness of the wool, the quantity of suet, and even the size of the body, vary greatly in different countries. In France, the province of Berri abounds most in sheep. Those about Beauvais, and in some other parts of Normandy, are fatter, and more charged with suet. They are very good in Burgundy; but the best are fed upon the sandy downs of our maritime provinces. The Italian, Spanish, and even the English wools are finer than the French wool. In Poitou, Provence, the environs of Bayonne, and several other parts of France, there is a race of sheep which have the appearance of being foreign. They are larger, stronger, and better covered with wool than the common kind. They are likewise more prolific, producing frequently two lambs at a time. The rams of this race engender with the common ewes, and produce an intermediate kind. In Italy and in Spain there are a great variety of races; but they ought all to be regarded as of the same species with our common sheep, which, though so numerous and diversified, extend not beyond Europe. Those animals with a long broad tail, so common in Asia and Africa, and which are called Barbary sheep by travellers, appear to be a species different from the ordinary kind, as well as from the pacos and lama of America.

As white wool is most valued, black or spotted lambs are generally slaughtered. In some places, however, almost all the sheep are black; and black lambs are often produced by the commixture of white rams with white ewes. In France there are only white, brown, black, and spotted sheep: but in Spain there is a reddish kind; and in Scotland there are some of a yellowish colour. But all these varieties of colour are more accidental than those produced by different races, which however proceed from the influence of climate, and the difference of nourishment.

THE GOAT.

THE horns of the goat bend backward, and are almost close at their base. There are eight cutting teeth in the lower jaw, and none in the upper. The hoofs are cloven; and the male is generally furnished with a beard.

Though the species of animals are separated from each other by an interval which nature cannot overleap, yet some species approach so near to others, and their mutual relations are so numerous, that space is only left for a bare line of distinction. When we compare these neighbouring species, and consider them in relation to ourselves, some appear to hold the first rank for utility, and others seem to be only auxiliary species, which might in many respects supply the place of the first. Thus the ass might nearly supply the place of the horse, and the goat that of the sheep. The goat, like the sheep, affords both milk and suet in considerable quantities. His hair, though coarser than wool, is capable of being made into very good cloth; his skin is more valuable than that of the sheep; and the flesh of the kid makes a near approach to that of the lamb, &c. These auxiliary species are more rustic and robust than the principals; the ass and the goat require not near so much attention as the horse and the sheep. They every where find the means of subsistence, eating almost indiscriminately the grossest as well as the most delicate plants. They are less affected by the influence of climate, and can better dispense with the aid of man. The less they depend on us, the more they seem to belong to nature; and instead of regarding these subaltern species as degenerated productions of the principal species, instead of considering the ass as a degenerated horse, it would be more consonant to reason, to say, that the horse is an improved ass; that the sheep is a more delicate kind of goat, which we have trained, raised to greater perfection, and propagated for our own use; and, in general, that the most perfect species, especially among domestic animals, derive their origin from those wild and less perfect kinds which make the nearest approach to the former. The powers of nature, when united to those of man, are greatly augmented.

Independent of reasonings of this kind, the goat is a distinct species, and perhaps still farther removed from the sheep than the ass from the horse. The buck as willingly copulates with the ewe as the jack-ass with the mare; and the ram embraces the she-goat in the same manner as the horse intermixes with the she-ass. But though these commixtures be frequent, and sometimes prolific, no intermediate species has been formed

between the goat and sheep. The two species are distinct, and still remain at the same distance from each other. No change has been effected by these mixtures; they have given rise to no new or middle race of animals; they have only produced individual differences, which have no influence on the unity of each primitive species, but, on the contrary, confirm the reality of their characteristic and essential distinction.

In many cases, however, we cannot distinguish these characteristic differences with sufficient certainty: in others, we are obliged to suspend our judgment; and in the greatest number, we have not a single ray of light to direct us: for independent of the uncertainty arising from the contradictory testimonies with regard to historical facts; independent of the doubts resulting from the inaccuracy of those who have endeavoured to study nature, the greatest obstacle to the advancement of knowledge proceeds from our ignorance of many effects which time alone has not been able to exhibit, and which will not be discovered, even by posterity, without numberless experiments, and the most accurate investigation. In the mean time we wander in darkness, perplexed between probabilities and prejudices, ignorant even of possibilities, and every moment confounding the opinions of men with the operations of nature. Examples are innumerable: but without leaving our subject, we know that the he-goat and ewe, and the ram and she-goat procreate together: we have still to learn, however, whether the mules produced by these commixtures be barren or fruitful. Because mules produced by the mixture of the horse with the she-ass, or the jack-ass with the mare, are sterile, we conclude that mules of every kind must likewise be deprived of the power of transmission. But this opinion may be false. The ancients assert positively, that the mule produces at the age of seven years; and that it likewise produces with the mare. They tell us, that the she-mule is capable of conception; but that she is unable to bring her fruit to perfection. The truth of these facts, which obscure the real distinctions of animals, as well as the theory of generation, should be either confirmed or destroyed. Besides, though we had a distinct knowledge of all the species of animals around us, we are still ignorant of what might be produced by intermixtures with each other, or with foreign animals. We have no proper information concerning the jumar, an animal said to be produced by the cow and jack-ass, or by the mare and bull. We know not whether the zebra can produce with the horse or ass, or the broad-tailed Barbary ram with the common ewe; whether the chamois goat be only the common goat in a wild state, and whether an intermediate race might not be formed by their mixture; whether the monkeys really differ in species, or whether they form but one species, diversified, like that of the dog, by a great number of different races; whether the dog can produce with the fox and the wolf, the stag with the cow, &c. Our ignorance of all these facts is almost invincible; for the experiments necessary to ascertain them would require more time, attention, and expence, than the life or fortune of most men can permit. I employed several years in making trials of this kind, of which an account shall be given when I treat of mules. But in the mean time, I acknowledge, that they afforded me very little information, and that most of my experiments were abortive.

Upon the determination of these and similar facts, however, our knowledge of the distinction of species, and of the genuine history of animals, as well as the manner of treating them, chiefly depends. But since we are deprived of this necessary knowledge; since it is impossible, for want of facts, to establish analogies, or to lay a proper foundation for reasoning, there is no other method left us than to proceed, step by step, to consider each animal individually, to regard as different species all those which spontaneously procreate together, and to write their history in detached articles, reserving a power of uniting or separating them, as soon as we shall acquire a more perfect knowledge, either from our own experience, or that of other men.

It is for this reason, that though there are many animals which resemble the sheep and goat, we here confine ourselves entirely to the domestic kinds. We know not whether the foreign kinds could intermix with the common species, and produce new races. We are therefore authorised to consider them as distinct species, till sufficient evidence is procured, that the foreign kinds can procreate with the common, and produce fertile individuals: this is the only character which constitutes the reality of what is called species both in the animal and vegetable kingdoms.

The goat is superior to the sheep both in sentiment and dexterity. He approaches man spontaneously, and is easily familiarized. He is sensible of caresses, and capable of a considerable degree of attachment. He is stronger, lighter, more agile, and less timid than the sheep. He is a sprightly, capricious, wandering, lascivious animal. It is with difficulty that he can be confined to a flock. He loves to retire into solitude, to climb steep and rugged places, to stand and even to sleep on the point of rocks, and the edges of the most frightful precipices. The female anxiously searches for the male; and they unite with ardour. They are robust and easily nourished; for they eat almost every herb, and are injured by a very inconsiderable number. The bodily temperament of the goat, which in all animals has a great influence on the natural dispositions, is not essentially different from that of the sheep. These two animals, whose internal organization is almost entirely similar, are nourished, grow, and multiply in the same manner; and their diseases are the same, except a few to which the goat is not subject. The goat fears not,

like the sheep, too great a degree of heat. He cheerfully exposes himself to the sun, and sleeps under its most ardent rays, without being affected with a vertigo, or any other inconveniency. He is not afraid of rain or storms; but he appears to feel the effects of severe cold. The external actions and movements of animals, which, as formerly remarked, depend more upon the strength and variety of their sensations, than the structure of their bodies, are for this reason, more vivacious and less limited in the goat, than in the sheep. The inconstancy of the goat's disposition is marked by the irregularity of his actions. He walks, stops short, runs, leaps, approaches, retires, shows, and conceals himself, or flies off, as if he were actuated by mere caprice, and without any other cause than what arises from an eccentric vivacity of temper. The suppleness of his organs, and the strength and nervousness of his frame, are hardly sufficient to support the petulance and rapidity of his natural movements.

That these animals are naturally friends to man, and that even in uninhabited countries, they betray no savage dispositions, is apparent from the following fact. In the year 1698, an English vessel having put into the island of Bonavista, two negroes came aboard, and offered *gratis* to the captain as many goats as he pleased. The captain having expressed his astonishment at this offer, the Negroes replied, that there were only twelve persons on the island; that the goats had multiplied so greatly as to become extremely troublesome; and that instead of being caught with difficulty, they obstinately followed the men, like other domestic animals.

The male is capable of engendering when he is a year old, and the female when she is seven months. But the fruits of such premature embraces are feeble and imperfect; and for this reason they are generally restrained till they arrive at the age of eighteen months or two years. The he-goat is a beautiful, vigorous, and ardent animal. In the course of two or three months, one male is sufficient for more than 150 females. But this ardour, which soon consumes him, lasts three or four years only, and at the age of five or six, he is old and enervated. Hence a male for breeding should be large, handsome, and not exceeding two years of age. His neck should be short and fleshy; his head light; his ears pendent; his thighs thick; his limbs firm; his hair black, thick, and soft; and his beard long and bushy. The choice of the female is not of equal importance. It may only be remarked, that those which have large bodies, thick thighs, a light walk, long and capacious udders, and soft bushy hair, ought to be preferred. The females are in season during the months of September, October, and November: but when allowed to approach the male, they are willing to receive him, and are capable of producing in all seasons. They, however, hold much surer in autumn; and the months of October and November are preferred; because the young kids are brought forth when the grass is tender. They go with young about five months, and are delivered in the beginning of the sixth. They suckle their young a month or six weeks. Thus six months and a half should be reckoned between the time when they are covered, and that when the kid begins to feed upon pasture.

When pastured along with sheep, the goats always take the lead of the flock. They love to feed separately upon the tops of hills, and prefer the most elevated and rugged parts of mountains. They find sufficient nourishment in heathy, barren, and uncultivated grounds. They do infinite mischief when permitted to go among corn, vines, copses, or young plantations; for they eat with avidity the tender bark and young shoots of trees, which generally proves fatal to their growth. They carefully avoid moist ground, marshy meadows, and rich pastures. They are seldom reared in plain countries, where they never thrive, and where their flesh is always bad. Vast quantities are reared in warm climates; and they are never put into stables. In France they would perish if not sheltered during winter. They require no litter in summer; but in winter, as moisture is very hurtful to them, they should be frequently supplied with fresh litter, and never allowed to lie upon their own dung. They are conducted to the fields very early in the morning, grass covered with dew, which is injurious to sheep, being extremely salutary to goats. As they are untractable and wandering animals, one man, however robust and active, is unable to manage above fifty of them. They are never permitted to go out during snow or hoar-frost; but are fed in the stable with herbage, small branches of trees collected in autumn, cabbages, turnips, and other roots. The more they eat, the quantity of their milk is the greater. To increase the quantity of milk still more, they are made to drink much, by mixing a little nitre or salt with their water. The milk may be drawn from them five days after bringing forth; and they continue to yield considerable quantities of it, every morning and evening, for four or five months. The female produces but one kid, though sometimes two, seldom three, and never more than four. She is fertile from one year or eighteen months, till she be seven years of age. The male may propagate as long, and perhaps longer, if he were properly managed; but he is seldom employed above five years. He is then sent to be fattened among the old and young male goats, which have been castrated, to render their flesh more tender, and succulent. These are fattened in the same manner as wedders. But whatever attention is bestowed on them, or however they are fed, their flesh is never so good as mutton, except in very warm climates, where mutton is always ill tasted.

The strong odour of the he-goat proceeds not from

his flesh, but from his skin. These animals, which are not permitted to grow old, might perhaps live ten or twelve years. Whenever they cease to multiply, they are killed; and the older they are their flesh is the worse. Both males and females, with very few exceptions, are furnished with horns. The colour of their hair is exceedingly various. It is said that those which are white and have no horns give most milk; and that the black goats are the strongest. Though the food of these animals costs almost nothing, yet they fail not to bring considerable profit. Their flesh, tallow, hair, and skin are valuable commodities. Their milk is more wholesome and better than that of the sheep: it is used as a medicine, curdles easily, and makes very good cheese. As it contains few oily particles only, the cream should never be separated from it.

The goat has no cutting teeth in the upper jaw. Those of the under jaw fall out, and are replaced in the same time, and in the same order, as the teeth of the sheep. The age of the goat is indicated by the teeth and the knobs of the horns. The number of teeth in the she-goat is not uniform: they are generally fewer than those of the male, whose hair is also more rude, and his beard and horns longer. These animals, like the ox and sheep, have four stomachs, and chew the cud. Their species is more universally diffused than that of the sheep. Goats, every way similar to our own, are found in many parts of the world. They are only smaller in Guinea and other warm climates, and larger in Muscovy and other northern regions. The goats of Angora or of Syria, with pendent ears, are of the same species with ours; for they intermix together, and produce even in our climates. The horns of the male are equally long with those of the common kind; but they are directed and contorted in a different manner. They extend horizontally from each side of the head, and form spirals nearly like those of a screw. The horns of the female are short, bend backwards, downwards, and then advance forwards, so as to terminate near the eyes; but their direction and contour are not always uniform.

SUPPLEMENT.

We are informed by Pontoppidan, that goats are so numerous in Norway, that from the port of Bergen alone, 80,000 raw hides are annually exported, without reckoning those which have been dressed. Goats, indeed, seem to be well adapted to the nature of this country: they search for their food upon the tops of the highest and most rugged mountains. The males are very courageous; they fear not the attack of a single wolf, and even assist the dogs in defending the flock.

THE HOG, THE HOG OF SIAM, AND THE WILD BOAR.

THE common hog or sow is cloven hoofed, and has cutting teeth in both jaws, and two large tusks above and below. The body is covered with bristles. In a wild state, it is of a dark brinded colour; beneath the bristles, there is soft, curled, short hair; and the ears are short, and a little rounded. When tame, the ears are long, sharp-pointed, and slouching; and the colour is generally whitish, but sometimes mixed with other colours.

I have joined these three animals, because they form but a single species. The one is the wild animal, the other two are the same animal, only in a domestic state. Though they differ in some external marks, and perhaps likewise in some habits; yet as these differences are not essential, but relative to their condition, as their nature is not altered by their slavery, and lastly, as they can produce by intermixture, fertile individuals, the only character which constitutes a distinct and permanent species, they ought not to be treated as separate animals.

These animals are remarkably singular: their species is solitary and detached. It is approached by no neighbouring species, which, like that of the horse and ass, and of the sheep and goat, may be regarded as principal or as accessory. Neither is it subject to a variety of races, like that of the dog. It participates of several species; but differs essentially from the whole. Let those who wish to limit the immensity of nature to the contracted views of imperfect systems, attend to this animal, and they will discover that it eludes all their methodical arrangement. Its extremities, which are cloven-hoofed, have no resemblance to those that are whole-hoofed. It even resembles not the cloven-hoofed animals; because, though it appears to have two toes only, it has actually four concealed within. It has no resemblance to the digitated quadrupeds; because it walks on two toes only, and the other two are neither so situated, nor extended so far, as to serve the purposes of walking. It has, therefore, equivocal or ambiguous characters, of which some are apparent and others concealed. Shall we consider this as an error of nature, and maintain, that the two internal toes should not be reckoned? But this error is constant. Besides, in this

animal, the other bones of the foot have no resemblance to those of cloven-footed animals; and there are other differences still more striking: for the latter have horns, and no teeth in the upper jaw; they have four stomachs, chew the cud, &c. But the hog has no horns, only one stomach, does not ruminate, and has cutting teeth both above and below. It is evident, therefore, that he belongs neither to the genus of whole-hoofed, nor to that of cloven-hoofed. He has as little pretension to be ranked with the digitated quadrupeds; for he differs from them not only in the extremity of his foot, but still more in his teeth, stomach, intestines, internal parts of generation, &c. All we can say is, that in some respects he forms the link between the whole and cloven-footed animals, and in others, between the cloven-footed and digitated animals; for in the number and arrangement of his teeth, he differs less from the whole-hoofed quadrupeds than from the other kinds. He also resembles them in the prolongation of the jaws, and, like them, he has but one large stomach; but by an appendix attached to it, as well as by the position of the intestines, he seems to approach towards the cloven-footed or ruminating animals. He likewise resembles them in the external parts of generation; and at the same time he resembles the digitated quadrupeds in the form of his legs in the habit of his body, and in the number of his progeny. Aristotle is the first writer who divided quadrupeds into whole-hoofed, cloven-hoofed, and digitated, and he allows that the hog is an ambiguous genus. But the only reason he assigns is, that in Illyria, Pœnonia, and some other places, there are whole-hoofed hogs. This animal still affords a kind of exception to two general laws of nature, namely, that the larger the animals, they are the less prolific; and that digitated animals are the most fertile. The hog, though of a size far beyond mediocrity, produces more than any other quadruped. By this surprising fecundity, as well as by the structure of the ovaria of the female, it seems to constitute the extremity of the viviparous species, and to approach to those of the oviparous. In fine, the hog seems to be of an equivocal nature, or rather he appears so to those who mistake the hypothetical arrangement of their ideas for the common order of nature, and who only perceive, in the infinite chain of being, some conspicuous points to which they incline to refer every natural phænomenon.

The number of paps, in every species of animals, it has been said, is proportioned to the number of young which the female is capable of producing and suckling. But why should the male, who never produces, have generally the same number of paps? And why should the sow, which often produces, eighteen, and even twenty pigs, have only twelve paps, and sometimes fewer? Does not this prove that the operations of nature are not to be judged of by final causes, or moral fitness, but by examining the manner in which she acts, and by employing, to acquire a knowledge of her, all those physical relations exhibited to us by the immense variety of her productions? I allow, that this method, which is the only path that can conduct us to real knowledge, is incomparably more difficult than the other, and that there are innumerable facts in nature, to which, like the preceding, it cannot be applied with success.

To the peculiarities already related, some others remain to be added. The fat of the hog differs from that of almost every other quadruped, not only in its consistence and quality, but in its position in the body of the animal. The fat of man, and of those animals which have no suet, as the dog, the horse, &c. is pretty equally intermixed with the flesh. The suet of the sheep, goat, deer, &c. is placed at the extremities of the flesh. But the lard of the hog is neither mixed with the flesh, nor collected at its extremities. It covers the whole animal in the form of a thick, distinct, and continued stratum between the flesh and the skin. This phænomenon likewise takes place in the whale and other cetaceous animals.

What is still more singular, the hog sheds not his fore-teeth; they continue to grow during life. He has six cutting teeth in the under jaw, and a corresponding number in the upper. But by an irregularity of which there is not another example in nature, the figure of the six teeth in the under jaw is different from that of those in the upper; for instead of being sharp and cutting, the latter are long, cylindrical, blunt at the points, and form nearly a right angle with those in the upper jaw; so that their extremities apply to each other in a very oblique manner.

Tusks, or very long canine teeth, are peculiar to the hog, and two or three other species of animals. They differ from other teeth by extending out of the mouth, and continuing to grow during life. In the elephant and sea-cow they are cylindrical, and several feet in length. In the wild boar and male hog, I have seen the tusks from nine to ten inches long. They are flat, sharp, and bend in a circular form. They sink very deep in the socket; and like those of the elephant, they have a cavity at their superior extremity. The tusks of the elephant and sea-cow are placed in the upper jaw, and there are no canine teeth in the under jaw. But the male hog and wild boar have tusks in both jaws; and those of the under jaw are most useful to the animal, and also most dangerous: for it is with them that the wild boar wounds those who attack him.

The common sow, the wild sow, and the castrated domestic boar, have likewise four canine teeth in the under jaw; but they are much less than those of the male, and never extend beyond the mouth. Besides these sixteen teeth, namely, twelve cutting and four canine, they have twenty-eight grinders, which make forty-four in all. The tusks of the wild boar are larger,

his snout stronger, and his head longer than those of the domestic hogs. His feet are also larger, his toes more separated, and his bristles are always black.

Of all quadrupeds the hog is the most rude and brutal. The imperfections of his form seem to have an influence on his nature and dispositions. All his habits are gross; all his appetites are impure; all his sensations are confined to a furious lust, and a brutal gluttony. He devours indiscriminately every thing that comes in his way, even his own progeny, the moment after their birth. This voraciousness seems to proceed from the perpetual cravings of his stomach, which is of an immoderate size; and the grossness of his appetites, it is probable, arises from the bluntness of his senses of taste and of feeling. The rudeness of the hair, the hardness of the skin, and the thickness of the fat, render these animals less sensible to blows. Mice have been known to lodge upon a hog's back, to eat his skin and his fat, without his showing any marks of sensibility. The other senses of the hog are very good. It is well known to the hunters, that the wild boar hears and smells at a great distance; for in order to surprise him, they are obliged to watch him in silence during the night, and to place themselves opposite to the wind, that he may not perceive the smell, which never fails to make him turn back.

The imperfection of the senses of taste and feeling in the hog is farther augmented by a leprous disease, which renders him almost totally insensible. This malady proceeds perhaps less from the texture of the flesh or skin than from the natural dirtiness of the animal, and the corruption that must result from the putrid food he sometimes devours; for the wild boar, who generally lives upon grain, fruits, acorns, and roots, is not subject to this distemper; neither is the pig while it continues to suck. There is no method of preventing it but by keeping the domestic hog in a clean stable, and feeding him with wholesome nourishment. His flesh will become excellent, and his fat firm and tender, if he is kept for fifteen days or three weeks in a paved stable, without litter, and always clean, giving him only dry wheat to eat, and allowing him to drink very little. For this purpose a hog of a year old, in good health, and half-fattened, should be chosen.

The ordinary method of fattening hogs is to give them plenty of barley, acorns, cabbages, boiled peas, roots, &c. and water mixed with bran. In two months they are fat; their lard is thick, but neither firm nor white; and their flesh though good is somewhat insipid. They may be fattened much cheaper in woody countries, which produce acorns and other nuts, by leading them into the forest during autumn, when chesnuts, acorns, beech-mast, &c. fall and quit their husks. They eat indiscriminately all wild fruits, and soon fatten, especially if, on their return in the evening, they be served with lukewarm water mixed with a little bran and pease-meal. This drink makes them sleep, and take on fat to such a degree, that they sometimes are unable to walk, or move themselves. They fatten much sooner in autumn than in any other season, both because their food is more plentiful, and because they lose less by perspiration than in the summer months.

In fattening hogs it is unnecessary to delay, as we do with other cattle, till they be full grown; for the older they are, they fatten with more difficulty, and their flesh is not equally good. Castration, which ought always to precede the fattening of hogs, is generally performed at the age of six months, and in the spring or autumn; because great heat or great cold renders the wound dangerous or difficult to cure; for the operation is commonly performed by incision, though sometimes by a simple ligature. When castrated in spring, they are fattened the following autumn, and are seldom allowed to live two years. However, they continue to grow during the second, third, fourth, and even the fifth year. Those which are remarkable for their size and corpulence are too old, and have been several times fed in the forest. The continuance of their growth seems not to be limited to four or five years. The boars kept for propagation grow larger during the sixth year; and the wild boar is larger and fatter in proportion to his age.

The life of the wild boar may be extended to twenty-five or thirty years. Aristotle says, that hogs in general live twenty years; and adds, that both males and females are fertile till they arrive at the age of fifteen. They can engender at the age of nine or twelve months; but it is better to restrain them till they be eighteen months or two years. The first litter of the sow is not numerous; and when only one year old, her pigs are weak, and even imperfect. She may be said to be in season at all times. Though full, she solicits the approach of the male. This may be regarded as an excess among animals; for almost every other species refuse the male after conception. The ardour of the sow, though almost perpetual, is, however, marked by paroxysms and immoderate movements, which always terminate by her wallowing in the mire. She at the same time emits a thick whitish fluid. She goes four months with young, brings forth in the beginning of the fifth, and soon afterwards solicits the male, is impregnated a second time, and of course brings forth twice a-year. The wild sow, which every way resembles the domestic kind, brings forth twice a-year. This difference in fertility is probably owing to want of nourishment, and the necessity of suckling her pigs much longer than the domestic sow which is never allowed to nurse her young above fifteen days or three weeks. Only eight or nine of the litter are kept longer; the rest are sold. In fifteen days, pigs are excellent food. As many females are unnecessary, and as castrated hogs bring most profit, their flesh being best, only two females, and seven or eight males, are left with the mother.

The male chosen for propagation should have a thick body, rather square than long, a large head, a short flat snout, large depending ears, small fiery eyes, a large thick neck, a flat belly, broad thighs, thick short legs, and strong black bristles. White hogs are never so strong as the black kind. The sow ought to have a long body, a large belly, and long dugs. She should also be of a placid temper, and sprung from a prolific race. Immediately after conception, she should be separated from the male, who is apt to injure her. When she brings forth, she should be fed plentifully, and watched to prevent her from devouring some of her young. Still greater attention is necessary to keep off the male, who would destroy the whole litter. The females are covered in the beginning of spring, that the pigs may be brought forth in summer, and have time to acquire strength and become fat before winter. But when two litters are wanted annually, the male is given in November, that the female may bring forth in March; and she is covered a second time in the beginning of May. Some sows produce regularly every five months. The wild sow, which produces but once a-year, receives the male in January or February, and brings forth in May or June. She suckles her young three or four months: she conducts, follows, and allows them not to separate from her till they be two or three years old; and it is not uncommon to see a wild sow accompanied with two or three litters. The domestic sow is not allowed to suckle her pigs above two months. At the end of three weeks, they are led to the fields along with the mother, to accustom them gradually to feed as she does. Five weeks afterwards they are weaned, and get every morning and evening a little milk mixed with bran, or only lukewarm water and boiled vegetables.

Hogs are fond of earth-worms and particular roots, as those of the wild carrot. It is in search of these worms and roots, that they dig the ground with their snouts. The wild boar, whose snout is longer and stronger than that of the domestic kind, digs deeper, and always nearly in a straight line: but the common hog digs irregularly and more lightly. As they do much mischief in cultivated fields, they should be fed in the forests, or in fallow land.

Wild boars, which have not passed their third year, are called by the hunters flock-beasts; because, previous to this age, they do not separate, but follow their common mother. They never wander alone till they have acquired strength sufficient to resist the attacks of the wolf. These animals, when they have young, form a kind of flocks; and it is upon this alone that their safety depends. When attacked, the largest and strongest front the enemy, and by pressing all round against the weaker, force them into the centre. The domestic hogs defend themselves in the same manner, and have no occasion to be guarded by dogs. But as they are obstinate and untractable, an active and robust man is unable to manage more than fifty of them. In autumn and winter, they are conducted to the woods, where wild fruits abound; in summer they are led to moist grounds, where they find plenty of worms and roots; and in spring they are allowed to go on waste or fallow lands. They are led out twice a-day from March to October, and feed from the time that the dew is dissipated in the morning, till ten o'clock, and from two in the afternoon till the evening. In winter they are let out only once a-day, when the weather is fine; for dew, snow, and rain, are hurtful to them. When overtaken with a storm, or even a great rain, they often desert the flock one after another, and run and cry till they arrive at the stable-door. The youngest cry oftenest and loudest. This cry, which differs from the ordinary grunting, resembles the cries they utter when bound with ropes, in order to be slaughtered. The male cries less frequently than the female. The wild boar seldom cries, unless when he is wounded in combat. The wild sow cries oftener; and when suddenly frighted, she blows with such violence as to be heard at a great distance.

Though extremely gluttonous, they never attack or devour other animals; but they sometimes eat putrid flesh. Wild boars have been observed eating the flesh of horses; and the skin of the roebuck, and the claws of birds, have been found in their stomachs. But perhaps this proceeds more from necessity than instinct. It cannot however be denied, that they are very fond of blood, and of fresh and bloody flesh; for hogs devour their own young, and even infants in the cradle. Whenever they find any succulent, moist, or unctuous substance, they first lick, and then swallow it. In their return from the fields, I have seen a whole herd stop round a piece of new ploughed clay-land, which, though but slightly unctuous, they all licked, and some of them swallowed considerable quantities of it. Their gluttony, as formerly remarked, is equally gross as their nature is brutal. They have no sentiments which are very distinct. The pigs hardly know their mother, or at least they are extremely apt to mistake her, and to suck the first sow that will permit them. Fear and necessity seem to confer more sentiment and instinct upon wild hogs. The young are more attached to their mother, and she appears to be more attentive to them, than the domestic sow. In the rutting season, the male follows the female, and generally remains with her about thirty days in the thickest and most solitary recesses of the forest. He is then more ferocious than ever: when another male endeavours to occupy his place, he becomes perfectly furious; and they fight, wound, and often kill each other. The wild sow is never furious but when her pigs are attacked: and it may in general be remarked,

that in almost all wild animals, the males during the rutting season, and the females after they bring forth, become more or less furious.

The wild boar is hunted with dogs, or killed by surprise during the night when the moon shines. As he flies slowly, leaves a strong odour behind him, and defends himself against the dogs, and often wounds them dangerously, fine hunting dogs are unnecessary, and would have their nose spoiled, and acquire a habit of moving slowly by hunting him. Mastiffs, with very little training, are sufficient. The oldest, which are known by the track of their feet, should only be attacked: a young boar of three years old is difficult to hunt down; because he runs very far without stopping. But the older boars do not run far, allow the dogs to run near, and often stop to repel them. During the day, he commonly remains in his soil, which is in the most sequestered part of the woods. He comes out in the night in quest of food. In summer, when the grain is ripe, it is easy to surprise him among the cultivated fields, which he frequents every night. As soon as he is slain, the hunters cut off his testicles, the odour of which is so strong, that in a few hours it would infect the whole flesh. The snout of an old boar is the only part that is esteemed; but every part of the castrated and young boar, not exceeding one year fed, makes delicate eating. The pork of the domestic boar is still worse than that of the wild boar; and can only be rendered fit for eating by castration and fattening. The ancients castrated the young boars which they could carry off from their mothers, and returned them to the woods, where they grew fat, and their pork was much better than that of domestic hogs.

To those who live in the country, the profits arising from the hog are well known. Pork sells nearly as dear as beef; the lard brings double or triple the price; the blood, the intestines, the feet, the tongue, are all prepared and used as food. The dung of the hog is colder than that of other animals, and should not be used but in grounds which are too warm and too dry. The fat of the intestines and web, which differs from common lard, is employed for greasing axles of wheels and many other purposes. Sieves are made of the skin, and brushes, pencils, &c. of the bristles. The flesh of the hog takes salt better, and keeps longer than that of any other animal.

This species, though very numerous, and diffused over Europe, Asia, and Africa, existed not in the New Continent, till they were transported thither, and to most of the American islands, by the Spaniards. In many places they have multiplied greatly, and become wild. They resemble our boars; and their bodies are shorter, and their snout and skin thicker than the domestic hogs, which in warm climates, are all black, like the wild boar.

By a ridiculous prejudice, which superstition alone could support, the Mahometans are deprived of this useful animal. They have been told that it is unclean; and therefore they dare not either touch or feed it. The Chinese, on the contrary, are extremely fond of pork. They rear hogs in numerous flocks, and pork is their most common food. This circumstance is said to have prevented them from embracing the religion of Mahomet. The Chinese hogs, as well as those of Siam and India, differ a little from the common kind. They are smaller, have shorter legs, and their flesh is whiter and more delicate. They are reared in several places of France; and they intermix and produce with the domestic hog. Numbers of them are reared by the Negroes; and though there are few of them among the Moors, or in the countries inhabited by Mahometans; yet wild boars are as common in Asia and Africa as in Europe.

Hence these animals affect not any particular climate: but the boar, by becoming domestic, seems to have degenerated more in cold than in warm countries. A very slight alteration of climate is sufficient to change their colour. In the northern provinces of France, and even in Viverais, the hogs are generally white; but in Dauphiny, which is at no great distance, they are all black; and those of Languedoc, Provence, Spain, Italy, India, China, and America, are of the same colour. The hog of Siam has a greater resemblance to the common hog than to the wild boar. The ears furnish the most evident mark of degeneration; for they become more supple, soft, inclined, or pendulous, in proportion as the animal is altered, or rather as he has been softened by education in a domestic state: and in fact, the ears of the domestic hog are more flexible, longer, and more inclined than those of the wild boar, which ought to be regarded as the model of the species.

THE DOG.

THE dog has six cutting teeth and two canine in each jaw: he has five toes on the fore feet, and four, and often five, on the hind feet. His tail bends towards the left, a character common to the whole, and first observed by Linnæus.

Neither majesty and elegance of form, strength of body, freedom of movement, nor other external qualities, constitute the principal dignity of animated beings. In man we prefer genius to figure, courage to strength, and sentiment to beauty; and therefore we are induced to think, that the chief excellence of an animal consists also of internal qualities. By these he differs from an automaton, rises above the vegetable tribes, and approaches the human species. It is sentiment which ennobles, governs, and gives activity to all his organs and propensities. Hence the perfection of an animal depends on sentiment alone; and in proportion to its extent, his faculties, resources, and relations with the rest of the universe, are augmented. When his sentiment is delicate, and improved by education, he is then fit to associate with man, to concur with his designs, to aid, to defend, and to caress him. By a frequent performance of these services he conciliates the favour of his master, and from a tyrant converts him into a friend and protector.

The dog, independent of the beauty of his figure, his strength, vivacity, and nimbleness, possesses every internal excellence which can attract the regard of man. A passionate, and even a ferocious and sanguinary temper, renders the wild dog formidable to all animals. But in the domestic dog, these hostile dispositions vanish, and are succeeded by the softer sentiments of attachment, and the desire of pleasing. He runs with chearfulness and alacrity to his master's foot, where he lays down his courage, his strength, and his talents. He attends for orders, which he is always solicitous to execute. He consults, he interrogates, he supplicates his master. A single glance of the eye is sufficient; for he knows the external signs of our intentions and wishes. Without being endowed, like man, with the faculty of thinking, his feelings are extremely delicate, and he has more fidelity and steadiness in his affection. He is not corrupted by ambition, by interested views, or by a desire of revenge; and he has no fear but that of displeasing. He is all zeal, ardour, and obedience. More apt to recal benefits than outrages, he is not discouraged by blows or bad treatment, but calmly suffers, and soon forgets them; or he remembers them only to increase his attachment. Instead of flying, or discovering marks of resentment, he exposes himself to torture, and licks the hand from which he received the blow. To the cruelty of his master he only opposes complaint, patience, and submission.

More tractable than man, and more pliant than any other animal, the dog is not only soon instructed, but even conforms himself to the manners, movements, and habits of those who govern him. He assumes the very tone of the family in which he lives. Like other servants, he is haughty with the great, and rustic with the peasant. Always eager to obey and to please his master, or his friends, he pays no attention to strangers, and furiously repels beggars, whom he distinguishes by their dress, their voice, and their gestures. When the charge of a house or garden is committed to him during the night, his boldness increases, and he sometimes becomes perfectly ferocious. He watches, goes the rounds, smells strangers at a distance, and if they stop or attempt to leap any barrier, he instantly darts upon them, and by barking and other marks of passion, alarms the family and neighbourhood. Equally furious against thieves as against rapacious animals, he attacks and wounds them, and forces them from whatever they have been attempting to carry off: but contented with victory, he lies down upon the spoil, and will not touch it even to satisfy his appetite, exhibiting at the same time an example of courage, temperance, and fidelity.

To conceive the importance of this species in the order of nature, let us suppose that it never existed. Without the assistance of the dog, how could man have conquered, tamed, and reduced the other animals into slavery? How could he still discover, hunt down, and destroy noxious and savage beasts? For his own safety, and to render him master of the animated world, it was necessary to form a party among the animals themselves, to conciliate by caresses those which were capable of attachment and obedience, and to oppose them to the other species. Hence the training of the dog seems to have been the first art invented by man; and the result of this art was the conquest and peaceable possession of the earth.

Most animals are superior to man in agility, swiftness, strength, and even in courage: nature has fortified and armed them better. Their senses, and particularly that of smelling, are likewise more perfect. To have brought over to our interest a bold and tractable species, like that of the dog, was to acquire new senses and

faculties. The machines and instruments we have invented to improve, or to extend our other senses, are not nearly so useful as those presented to us ready made by nature, which, by supplying the defects of our smelling, have furnished us with great and permanent resources for conquest and dominion. The dog, ever faithful to man, will always maintain a portion of this empire; he will always preserve a degree of superiority above the other animals. He reigns at the head of a flock, and is better heard than the voice of the shepherd. Safety, order, and discipline, are the fruits of his vigilance and activity. Sheep and cattle are a people subjected to his management, whom he prudently conducts and protects, and never employs force against them but for the preservation of peace and good order.

But in war against his enemies, or wild animals, he makes a full display of his courage and intelligence. Here his natural and acquired talents are united. As soon as the din of arms is heard, as soon as the horn, or the voice of the hunter gives the alarm, the dog, sparkling with redoubled ardour, demonstrates his joy by the most lively emotions: he announces, by his movements and cries, his impatience for the combat, and his passion for victory. Sometimes he moves silently along, reconnoitres the ground, and endeavours to discover and surprise the enemy. At other times he traces the animal's steps, and by different accents indicates the distance, the species, and even the age of the fugitive. Pushed, intimidated, and despairing of safety from flight alone, the poor animal likewise exerts its faculties, and opposes craftiness to sagacity. The resources of instinct are now worthy of admiration. To make him lose the scent the creature doubles, returns on its former steps, bounds, and wishes to detach itself from the earth; at one leap it often clears a high-way or a hedge, and swims over brooks and rivers. But always pursued, and being unable to conceal or annihilate its body, the animal endeavours to start another of less experience, and after running together till the former imagines that the two scents or traces are confounded, it then suddenly separates, in order to let the other fall a victim to the deceived enemy.

But the dog, by the superiority he has acquired from habit and education, and from the peculiar fineness of his sensations, loses not the object of his pursuit. By the acuteness of his scent, he unravels all the windings of the labyrinth, all the false routes which were intended to deceive him; and instead of abandoning the enemy for an indifferent animal, he redoubles his ardour, he overtakes, attacks, slays, and extinguishes his thirst and his rage in the blood of the victim.

The propensity to hunting, or to war, is equally strong in man as in other animals. The whole knowledge of the savage is confined to fighting and hunting. All carnivorous animals, which have weapons and strength, hunt naturally. The lion and the tiger, whose strength is so great as to ensure them of victory, hunt alone, and without artifice. Wolves, foxes, and wild dogs, hunt in packs, assist each other with much art, and mutually share in the prey. When the natural talents of the dog have been improved by education, when he has learned to repress his ardour, and to regulate his movements, he then hunts artificially, and is always certain of success.

In desert and depopulated countries, there are wild dogs, which in their manners differ not from wolves, except by the facility with which they may be tamed. They unite in troops, and attack wild boars and bulls, and even lions and tigers. The wild dogs of America are of the domestic race, and were transported thither from Europe. Some of them have been abandoned in these deserts, where they have multiplied so prodigiously, that they spread over the inhabited countries in great packs, and attack the domestic cattle, and even insult the natives, who are obliged to disperse and kill them like other ferocious animals. Wild dogs, though they have no knowledge of man, when approached with gentleness, soon soften, become familiar, and remain faithfully attached to their masters. But the wolf, though taken young, and brought up in the house, is gentle when a mere cub only, never loses his taste for prey, and sooner or later indulges his inclination for rapine and destruction.

The dog may be said to be the only animal whose fidelity is unshaken; who always knows his master and the friends of the family; who distinguishes a stranger as soon as he arrives; who understands his own name, and the voices of the domestics; who confides not in himself; who calls on his lost master by cries and lamentations; who, in long journeys, which he has travelled but once, remembers and finds out the roads: in fine, the dog is the only animal whose natural talents are conspicuous, and whose education is always successful.

Of all animals, the dog is also most susceptible of impressions, most easily modified by moral causes, and most subject to alterations occasioned by physical influence. His temperament, faculties, and habits, vary prodigiously; and even the figure of his body is by no means constant. In the same country, one dog differs greatly from another; and in different climates, the very species seems to be changed. From these causes, the number and mixture of races are so great, that it is almost impossible to recognise or enumerate them. To the same causes must be attributed those remarkable varieties in size, figure, length of muzzle, form of the head, length and direction of the ears and tail, colour, quantity of hair, &c. In a word, nothing seems to be permanent in these animals but their internal organization, and the faculty of procreating together. As those which differ most from each other are capable of inter-

mixing, and of producing fertile individuals, it is evident, that all dogs, however diversified, constitute but one species.

In this numerous variety of races, it is difficult to investigate the character of the primitive stock from which they have all sprung. How shall the effects produced by the influence of climate, food, &c. be distinguished? How shall we perceive the changes introduced by the mixture of different races when in a wild, or in a domestic state? In the progress of time, all these causes alter the most permanent forms; and the original stamp of Nature never preserves its purity in beings which have been long under the management of man. This original impression is best preserved in those animals that have the independent choice both of their climate and food, the most ancient of which are still faithfully represented by their descendants. But those which man has subdued, transported from climate to climate, and changed their food, their habits and manner of living, must necessarily have suffered the greatest alterations in their form; and it is a well known fact, that there are more varieties among the domestic than the wild animals: and of all domestic animals, as the dog is most closely attached to man, lives as irregularly, and is endowed with dispositions which render him docile, obedient, susceptible of every impression, and submissive to every restraint, it is not surprising that he should likewise exhibit the greatest variety in figure, size, colour, and other qualities.

But other causes concur in producing these changes. The life of the dog is short; his prolific powers are great; and as he is perpetually under the eye of man, whenever by any accident, which is not uncommon in Nature, some individuals marked with singular characters appeared, they would be perpetuated by preventing their intermixture with any other kinds, as is done at present when we want to procure new races of dogs, or of other animals. Besides, though every species were equally ancient, the number of generations, from the creation, being greater in those whose lives are short, their varieties, alterations, and even degeneration, must become more conspicuous; because they are farther removed from the original stock than those which live longer. Man is at present eight times nearer Adam, than the dog to his first parent; because man lives eighty years, and the dog only ten. If therefore, by any cause, these two species had an equal tendency to degenerate, the alteration would be ten times more strongly marked in the dog than in man.

Those small animals whose lives are so short, that they are succeeded every year by a new generation, are infinitely more subject to variations of every kind than those which live longer. The same remark is applicable to annual plants; some of which may be considered as of an artificial or factitious nature. Wheat, for example, has been so greatly altered by man, that it is now no where to be found in a natural state. It has a similarity to darnel, dog's-grass, and several other grasses; but still we know not to which of these plants it ought to be referred: and as it is annually renewed, is used as the common food of man, and more cultivated than any other vegetable, its nature of course, has undergone the greatest alterations. Hence man is able, not only to make every individual in the universe answer his own ends, but with the assistance of time, he can change, modify, and improve their species. This is the chief power he possesses over nature. To have transformed a barren herb into wheat, is a kind of creation, of which however we have no reason to boast, since it is only by the sweat of our brows, and reiterated culture, that we are able to extract from the earth a scanty, and often a bitter subsistence.

Hence, both in the animal and vegetable kingdoms, the species which have received the highest culture from man, have undergone the greatest changes from their original condition: and as we are often unable to recognise their primitive form, as in the example of wheat and other grain, it is not impossible, that among the numerous varieties of dogs which at present subsist, not one of them should resemble the first animal of the species that virtually gave birth to the whole.

Nature, however, when not restrained, never fails to resume her rights. Wheat, when sown on uncultivated ground, degenerates the very first year; and if sown for a succession of ages upon the same ground, the degeneration would gradually proceed till the plant acquired its original form. By an experiment of this kind, the time required by Nature for destroying the effects of art, and resuming her pristine state, might be discovered. This experiment might be easily performed on plants: but in animals, there is little hope of its success; because it is difficult to manage them with sufficient dexterity, or to overcome their invincible repugnance against every thing that restrains or counteracts their natural or acquired habits. We cannot, therefore, expect to learn by this method, the primitive race of dogs, or of other animals which are subjected to permanent varieties. But to supply the place of facts which cannot be ascertained, we may collect particular marks, and from these draw probable conjectures.

The domestic dogs which were abandoned in the deserts of America, and have lived in a wild state during 150 or 200 years, though originally derived from altered races, must during so long a course of time have made greater or smaller approaches towards their primitive form. Travellers, however, inform us, that they resemble our greyhounds. They make the same remark with regard to the wild dogs of Congo, which, like those of America, make war in packs against tigers, lions, &c. But others, without comparing the wild dogs of St.

Domingo to greyhounds, only observe, that they have generally a long flat head, a slender muzzle, a ferocious air, and meagre bodies; that they are exceedingly swift in the chase, hunt in the most perfect manner, and are easily tamed, when taken young. Thus these wild dogs are very meagre and fleet; and as the common greyhound differs little, in other respects, from the Irish greyhound, or from the shepherd's dog, it is probable that those wild dogs rather belong to this kind than to the true greyhound race; for on the other hand, the more ancient travellers tell us, that the native dogs of Canada had erect ears like the fox, and resembled our village or shepherd's dog; that those belonging to the savages of the Antilles had very long heads and ears, and approached to the figure of foxes; that the Indians of Peru had only a large and a small kind, which they called Alco; and that those of the Isthmus of America were very ugly, and had long coarse hair, which likewise implies erect ears. Hence it is apparent, that the original dogs of America, before they had any communication with those of Europe, were all of one race, and that they approached most to the dogs with slender muzzles, erect ears, and coarse hair, like the shepherd's dog: and I am still farther convinced that the wild dogs of St. Domingo are not genuine greyhounds, because the latter are so rare in France, that they are brought for the use of the King, from Constantinople and other parts of the Levant, and because I never knew that any greyhounds were transported to France from St. Domingo, or any of our American colonies. Besides by consulting what travellers had said concerning the dogs of different countries, we find that all the dogs of cold climates have long muzzles and erect ears; that those of Lapland are small, and have long hair, erect ears, and sharp muzzles; that the Siberian dogs, and those called wolf dogs, are larger than the Lapland kind; but their ears are still erect, their hair coarse, and their muzzle sharp; that those of Iceland are nearly similar to the Siberian dog; and in the same manner, that the native dogs of the Cape of Good Hope, and other warm climates, have pointed muzzles, erect ears, long trailing tails, and clear, but long, rough hair; that these dogs are excellent for guarding flocks, and of course, that they resemble the shepherd's dog, not only in figure, but in instinct; that in still warmer climates, as at Madagascar, Madura, Calicut, and Malabar, the native dogs have all long muzzles, erect ears, and have such a resemblance to the shepherd's dog, that when Irish greyhounds, spaniels, water-dogs, bull-dogs, blood-hounds, greyhounds, &c. were transported thither, they degenerated at the second or third generation; lastly, that in excessive warm countries, as in Guinea, this degeneration is still quicker; for in three or four years they lose their voice, bark no more, but make a dismal kind of howling noise; and their progeny have erect ears, like the fox. The native dogs of these countries are ugly animals, with sharp muzzles, long erect ears, and long pointed tails. There is no hair on their bodies; their skin is commonly spotted, but sometimes of a uniform colour: in a word, they are disagreeable to the eye, and still more so to the touch.

We may therefore suppose with some degree of probability, that the shepherd's dog approaches nearer to the primitive race than any of the other kinds; for in every country inhabited by savage or by half civilized men, the native dogs resemble this race more than any other. Besides, in the whole of the New Continent there was no other variety; neither is there any other at the south and north extremities of our own continent; and in France, and other temperate climates, they are very numerous, though greater attention has been paid to the rearing of more beautiful kinds, than to the preservation of this race, which has no recommendation but its utility, and for that reason has been abandoned to the care of the sheep farmers. If it be farther considered, that this dog, notwithstanding his ugliness, and his wild and melancholy aspect, is superior in instinct to all others; that he has a decided character, independent of education; that he alone is born fully trained; that, guided solely by natural powers, he applies himself spontaneously to the keeping of flocks, which he executes with amazing fidelity, vigilance, and assiduity; that he conducts them with an admirable and uncommunicated intelligence; that his talents at the same time astonish and give repose to his master, while other dogs require the most laborious instruction to train them to the purposes for which they are destined; we will be confirmed in the opinion, that the shepherd's dog is the true dog of Nature; that he has been preferably bestowed on us for the extent of his utility; that he has a superior relation to the general order of animated beings, who mutually depend on each other; and lastly, that he ought to be regarded as the origin and model of the whole species.

In the frozen regions of the north, the human species is deformed, rustic, and diminutive. Lapland, Greenland, and all countries where the cold is excessive, produce only dwarfish and ugly men. But in the neighbouring and less rigorous regions of Finland, Denmark, &c. the most beautiful race suddenly appears; for in figure, colour, and stature, they are perhaps the handsomest of the human kind. The same phænomenon is exhibited in the dog species. The Lapland dogs are very ugly, and so small, that they exceed not a foot in length. Those of Siberia, though less ugly, have erect ears, and a savage aspect: but in the neighbouring climate, where we meet with the handsome men already mentioned, we find also the most beautiful and largest dogs. The dogs of Tartary, of Albania, of the north of Greece, of Denmark, and of Ireland, are the largest and

strongest of the species, and are used for drawing carriages. The Irish greyhounds are of a very ancient race, and still exist, though their number is small, in their original climate. They were called by the ancients dogs of Epirus, and Albanian dogs. Pliny has recorded, in most elegant and energetic terms, a combat between one of these dogs, first with a lion, and then with an elephant. They are much larger than the mastiff. In France they are so rare that I never saw above one of them, which appeared, when sitting, to be about five feet high, and resembled in figure the Danish dog; but greatly exceeded him in stature. He was totally white, and of a mild and peaceable disposition. We find then in all the temperate climates, as in Britain, France, Germany, Spain, and Italy, men and dogs of all races. This variety proceeds partly from the influence of climate, and partly from the great concourse and intermixture of foreigners. With regard to dogs, I shall mark with all possible attention, the similarities and differences which shelter, care, food, and climate, have produced among these animals.

The Danish dog, the Irish greyhound, and the common greyhound, though they appear to be different, are only the same dog. The Danish dog is but a more corpulent Irish greyhound; and the common greyhound is the Irish greyhound rendered thinner and more delicate by culture; for these three dogs, though perfectly distinguishable at first sight, differ not more from each other than a Dutchman, a Frenchman, and an Italian. If we suppose the Irish greyhound to have been a native of France, he would have produced the Danish dog in a colder climate, and the common greyhound in a warmer one: and this conjecture is even verified by experience; for the Danish dogs come to us from the north, and the greyhounds from Constantinople and the Levant. The shepherd's dog, the Pomeranian or wolf-dog, the Siberian dog, to which may be joined the Lapland dog, the Canadian dog, the Hottentot dog, and all those which have erect ears, constitute but one kind. They differ from the shepherd's dog only in stature, in being more or less gross, or in the length, coarseness, or bushiness of their hair. The hound, the harrier, the turnspit, the water-dog, and even the spaniel, may be regarded as one dog. Their figure and instincts are nearly the same; and they differ only in the length of their legs and the size of their ears, which, however, in all of them are long, soft, and pendulous. These dogs are natives of France; and I am uncertain whether the Dalmatian dog, or, as it is called, the harrier of Bengal, ought to be disjoined from them; for it differs from our harrier only in colour. I am convinced that this dog is not an original native of Bengal, or of any other part of India, and that it is not, as has been pretended, the Indian dog mentioned by the ancients, and said to have been produced between a dog and a tiger; for it has been known in Italy above 170 years ago, and not considered as a dog brought from India but as a common harrier.

Britain, France, Germany, &c. appear to have given birth to the hound, the harrier, and the turnspit: when transported into climates a little warmer, as Turkey or Persia, these dogs degenerate. But the spaniels and water-dogs are natives of Spain and Barbary, where the temperature of the climate renders the hair of all animals longer and finer than in any other country. The bull-dog, what is improperly called the small Danish dog, for it has no other resemblance to the Danish dog than the shortness of its hair, the naked or Turkish dog, and the Iceland dog, constitute but one race, which, being transported from cold countries, where the fur is always strong, into the warmer climates of Africa and India, have lost their hair; for the naked dog is improperly called the Turkish dog: it is not in the temperate climate of Turkey that dogs lose their hair, but in Guinea, and the warm regions of India. The Turkish dog is nothing but the small Danish dog, which has first been transported to a very warm climate, where it cast its hair, and afterwards brought to Turkey, and propagated carefully on account of its singularity. The first of them, says Aldrovandus, which appeared in Europe, were brought into Italy in his own time, where they could not be propagated, because the climate was too cold for them. But as he gives no description of these naked dogs, we know not whether they were similar to what is now called the Turkish, nor, consequently, whether they can be referred to the small Danish dog; because dogs of every kind lose their hair in very warm climates; and, as formerly remarked, they also lose their voice. In some countries they are perfectly mute; in others, they lose only the faculty of barking, but howl like wolves, or yelp like foxes. This change seems to make them approach to their natural state; for both their figure and instincts are altered: they assume an ugly aspect, and their ears become erect and pointed. It is only in temperate climates that dogs preserve their ardour, courage, sagacity, and other talents. They lose every thing when transported to very hot countries. But, as if nature never made any being perfectly useless, in climates where dogs cannot serve the purposes for which we employ them, they are in great request for the table, and their flesh is preferred by the negroes to that of all other animals. They sell dogs in the market as dear as mutton, venison, or game of any kind, a roasted dog being the most luxurious feast to a Negro. Perhaps this remarkable appetite for dogs flesh is owing to a change produced in its quality by the heat of the country; for in our climates it is extremely disagreeable. But I am inclined to think that this appetite depends more on the nature of man than that of the dog; for the savages of Canada, who inhabit a cold country, are as

fond of dogs flesh as the negroes. P. Sabard Theodat remarks, 'that dogs are used, as we use mutton, at 'feasts. I have several times been present at these dogs-'feasts, which at first struck me with a degree of horror; 'but after tasting it twice, I found that the flesh was 'good, and had a flavour somewhat resembling that 'of pork.'

In our climates the wolf and fox make the nearest approach to the dog, particularly to the shepherd's dog, which I consider as the original stock of the species; and as their internal structure is almost entirely the same, and their external differences very slight, I wished to try if they would intermix and produce together. I hoped at least to make them copulate; and if they produced not fertile individuals, I expected to procure mules which would participate of the nature of both animals. With this view I reared a she-wolf, taken in the woods at the age of three months, along with an Irish greyhound of the same age. They were shut up together in a pretty large court, to which no other beast could have access, and where they were provided with a shelter for their retirement. They were equally strangers to any individual of their own species, and knew no person but the man who gave them their victuals. They were kept in this state three years without the smallest restraint. During the first year they playe perpetually, and seemed to be extremely fond of each other. The second year they began to quarrel about their food, though they were supplied in a plentiful manner. The wolf always began the dispute. When meat and bones were given them on a large wooden dish, the wolf, instead of seizing the meat, instantly drove off the dog, then laid hold of the edge of the plate so dexterously as to allow nothing to fall, and carried off the whole. I have seen her run, in this manner, with the dish in her teeth, five or six times round the wall, and never set it down, unless to take breath, to devour the meat, or to attack the dog, when he approached. The dog was stronger than the wolf: but as he was less ferocious, we began to be apprehensive of his life, and therefore furnished him with a collar. After the second year these quarrels and combats became more frequent, and more serious, and a collar was also given to the wolf, whom the dog now handled more roughly than before.

During these two years not the smallest symptom of desire appeared either in the one or the other. At the end of the third year they began to feel all the ardour of passion; but discovered no marks of love. This condition, instead of softening and making them approach each other, rendered them more untractable and ferocious. Nothing now was heard but dismal howlings and cries of resentment. In three weeks they were both very meagre; but never approached except to tear each other. At last they fought so cruelly that the dog killed the wolf. The dog was shot some days after, because as soon as he was set at liberty, he sprung with fury upon poultry, dogs, and even men.

I had, at the same time, three young foxes, two males and a female, which were taken with nets, and kept in separate apartments. One of them was secured by a long, light chain, and a hut was built for sheltering him. I kept him several months; and though he had a melancholy air, and kept his eyes fixed upon the fields, of which he had a view from his hut, yet both his health and appetite were good. A bitch in season was presented to him; but as she would not remain near the fox, she was chained in the same place, and both were amply provided with victuals The fox neither bit nor maltreated her. During ten days that they lived together there was not the smallest quarrel; neither night nor day, nor during the time of feeding. The fox even approached her pretty familiarly; but as soon as he had scented her too near, the mark of desire disappeared, he mournfully returned to his hut, and no commixture took place. When the ardour of this bitch was gone, another, and afterwards a third, and a fourth, were successively presented to him. He treated them with the same gentleness, and the same indifference. To ascertain whether this indifference was owing to a natural repugnance, or to a state of restraint, he was furnished with a female of his own species, which he covered more than once the first day. The female was dissected some weeks after, and four fœtuses were found in the uterus. The male fox was then let loose in a close court, and successively furnished with several bitches in season: he discovered neither hatred nor love to them; and he died of chagrin and melancholy a few months afterwards.

From these experiments we learn, that the wolf and fox are very different in their natures from the dog; that their species are so distinct and remote from each other as to prevent their commixture, at least in our climates; that, consequently, the dog derives not his origin from the wolf or the fox; and that the nomenclators, who regard these two animals as wild dogs, or who imagine the dog to be a wolf or a fox become domestic, and give the whole three the common name of dog, have deceived themselves by not sufficiently studying nature.

In warm climates, there is a ferocious animal which differs less from the dog than the wolf or fox: this animal, called the Jackal, has been well described by travellers. They are very numerous in Asia, and Africa, in the neighbourhood of Trebisond, round Mount Caucasus, in Mingrelia, Natolia, Hyrcania, Persia, India, Guinea, and at Surat, Goa, Guzarat, Bengal, Congo, and several other places. Though this animal is considered by the natives as a wild dog, yet as it is doubtful whether they intermix and produce together, we shall treat of the jackal, the wolf, and the dog, as separate and distinct species.

I pretend not absolutely to affirm, that the jackal, or even the wolf and fox, in no age or country, never intermixed with dogs. The contrary is asserted positively by the ancients. Aristotle remarks, that though animals of different species seldom intermingle, yet it certainly happens among dogs, foxes, and wolves: he adds, that the Indian dogs proceed from another similar wild beast and the dog. This wild beast, to which he gives no name, is probably the jackal. But he observes in another place, that the Indian dogs proceed from a commixture between the tiger and the bitch. This notion is extremely improbable; because the tiger, both in his form and dispositions, differs much more from the dog than the wolf, the fox, or the jackal. Aristotle indeed appears to violate his own argument; for after telling us that the Indian dogs proceeded from a wild beast similar to the wolf or fox, he says afterwards, that they proceed from the tiger, without mentioning whether this conjunction was made between the tiger and bitch, or between the dog and tigress: he only adds, that the affair did not succeed till the third trial; that the first litter consisted solely of tiger; that dogs were chained in the deserts, and unless the tiger was in season, they were often devoured; that the great heat, and scarcity of water, made the production of monsters and prodigies very frequent in Africa, because numbers of animals were obliged to assemble in the same place in order to drink, where they often grew familiar and coupled together. All this seems to be not only conjectural and uncertain, but suspicious and unworthy of credit; for the more narrowly we examine the nature of animals, we perceive that instinct is the most certain criterion for judging of them. By the most attentive inspection of their internal parts, we discover only slight differences. The horse and ass, though perfectly similar in their internal structure, are very different in their natures. The internal parts of the bull, the ram, and the he-goat, are exactly the same; yet they constitute three species more remote from each other than the ass and horse; the same remark is applicable to the dog, the fox, and the wolf. We derive more light from inspecting the external form. But as in species which are not remote, there are even externally more resemblances than differences, this inspection is not sufficient to determine whether they belong to the same or to different species. In a word, when the shades are still lighter, they must be combined with the information derived from instinct. It is from the dispositions of animals that we ought to judge of their natures: if we suppose two animals perfectly similar in form, but very different in their dispositions, they would neither join nor produce together, but constitute two distinct species.

This mode of judging concerning the differences of neighbouring species, is the only one that can be employed when we want to distinguish the numerous varieties which take place in the same species. We know thirty fixed varieties of dogs, though we certainly are not acquainted with the whole. Of these thirty varieties, there are seventeen which ought to be ascribed to the influence of climate, namely, the shepherd's dog, the Pomeranian dog, the Siberian dog, the Iceland dog, the Lapland dog, the Irish greyhound, the common greyhound, the mastiff, the great Danish dog, the hound, the harrier, the terrier, the spaniel, the water-dog, the small Danish dog, the Turkish dog, and the bull-dog. The other thirteen, which are the mongrel Turkish dog, the greyhound with hair like a wolf, the shock-dog or lap-dog, the bastard pug-dog, the pug-dog, the Calabrian, Burgos, and Alicant dogs, the lion-dog, the small water-dog, the dog of Artois, and the King Charles's dog, are nothing but mongrels produced by the commixture of the above seventeen races; and by tracing each of these mongrels back to the two races from which they sprung, their natures will then be sufficiently ascertained. But if we want to know the relations which subsist between the first seventeen races, we must attend to their instincts, their figure, and many other circumstances. I have put into one group the shepherd's dog, the Pomeranian dog, the Siberian dog, the Lapland and Iceland dogs, because a stronger resemblance takes place between them than between any of the other kinds, and because all of them have sharp muzzles like the fox, erect ears, and an instinct which induces them to follow and protect flocks. The greyhound, the large Danish dog, and the Irish greyhound, have, beside their similarity in figure and length of muzzle, the same dispositions: they are fond of running, and of following horses and carriages. They have little scent, and hunt rather by the eye than the nose. The hounds, the harriers, the spaniels, the terriers, and the water dogs, are the true hunting dogs. Though they differ a little in figure, they have all thick muzzles, and the same instincts; and therefore they ought to be ranked together. The spaniel for example, has been called by some naturalists, *canis aviarius terrestris*, and the water dog, *canis aviarius aquaticus*. The only difference in disposition between these two dogs is, that the water dog, with his long bushy hair, takes the water more cheerfully than the others, whose hair is smooth and short. Lastly, the small Danish dog and the Turkish dog must be joined together, since the latter is said to be the same dog with the former, only deprived of his hair by the effects of heat. There remains only the bull-dog, which, from the shortness of his muzzle, resembles the little Danish dog, but differs from him so much, both in figure and instinct, as to form a particular variety. He seems also to affect a particular climate: he comes from Britain, and it is difficult to preserve the breed in France. The mongrels that proceed from him,

which are the mastiff and the pug-dog, succeed better. All these dogs have very short muzzles, little scent, and often send forth a disagreeable smell. The fineness of the scent seems to depend more on the largeness than the length of the muzzle; for the greyhound, the large Danish dog, and the Irish greyhound, have less scent than the hound, the harrier, the terrier, the spaniel, or the water-dog, who have all, in proportion to their size, shorter, but broader muzzles, than the former.

The greater or less perfection of the senses forms not, in man, an eminent or remarkable quality; but bestows on the other animals all their merit, and produces as a cause, all the talents of which they are susceptible. I mean not to enumerate all the qualities of hunting dogs. The superiority they possess over other animals, by the excellence and acuteness of their sense of smelling is well known. But details of this kind are remotely connected with natural history. Besides, the artifices and dexterity, though derived solely from Nature, employed by wild animals to conceal themselves, or to avoid the pursuit of the dogs, are perhaps more worthy of admiration than the most refined methodical exhibitions derived from the art of hunting.

The dog, like every other animal which produces above one or two at a time, is not perfectly formed immediately after birth. Dogs are commonly brought forth blind. The two eyelids are not simply glued together, but shut up with a membrane, which is torn off as soon as the muscles of the upper eyelid acquire strength sufficient to overcome this obstacle to vision, which generally happens about the tenth or twelfth day. At this period the bones of the head are not completed, the body and muzzle are turgid, and the whole figure is ill defined. But in less than two months, they learn to use all their senses; their growth is rapid, and they soon acquire strength. In the fourth month they lose some of their teeth, which, as in other animals, are soon replaced, and never again fall out. The number of teeth is forty-two, namely, six cutting and two canine teeth in each jaw, and fourteen grinders in the upper and twelve in the under. But the number of grinders is not uniform, being greater or less in particular dogs. When very young, both males and females squat down a little to void their urine: in the ninth or tenth month, they begin to raise the thigh when they perform this operation; and at the same period, they acquire the capacity of procreating. The male is ready at all times; but the female receives him only at certain fixed seasons, which generally happen twice a-year, and more frequently in winter than in summer. The ardour of the female continues ten, twelve, and sometimes fifteen days; and it is known by external signs, which appear some days before she admits the male: the parts become moist and prominent; and this phænomenon is always accompanied with a small flux of blood. The male discovers the condition of the female by a peculiar smell; but she seldom receives him for the first six or seven days. One embrace is sometimes sufficient to make her conceive a great number of young; but when not restrained, she will admit several dogs every day. She seems to have no predilection, except in favour of the largest dogs, without regarding their figure or beauty. Hence it frequently happens, that a small female, who has admitted a large male, dies in bringing forth her young.

By a peculiarity in these animals, arising from the structure of their organs, they are incapable of separating, after consummation, but are obliged to remain united as long as the erection subsists. The dog, like several other animals, has not only a bone in the penis, but in the middle of the corpus cavernosum, there is a large hollow ring, which in time of copulation swells to a considerable size. The female, on the other hand, has a larger clitoris than perhaps any other animal; besides, in the time of coition, a large firm protuberance arises, and remains, perhaps, longer than that of the male, and prevents him from retiring till it subsides; for immediately after consummation he changes his position, in order to repose on his four legs; his aspect is melancholy, and the efforts for separation never proceed from the female.

The time of gestation is nine weeks, or 63 days, sometimes 62 or 61, but never less than 60. The females produce six, seven, and sometimes even twelve puppies. The largest and tallest are more prolific than the smaller kinds, which often produce only four or five, and sometimes but one or two, especially at the first litters, which in all animals are always less numerous than the subsequent.

Dogs, though extremely ardent in their amours, continue to propagate during life, which is generally limited to fourteen or fifteen years, though some have been known to live to the age of twenty. The duration of life in the dog, as in other animals, is proportioned to the time of his growth, which is not completed in less than two years, and he lives fourteen. His age may be discovered by his teeth, which, when young, are white, sharp, and pointed: but as he increases in years, they become black, blunt, and unequal. It may likewise be known by the hair, which turns gray on the muzzle, front, and round the eyes.

These animals, which are naturally vigilant, active, and frolicksome, by being over-fed in our houses, become so heavy and slothful, that they pass their lives in sleeping and eating. Their sleep, which is almost perpetual, is accompanied with dreams, which is perhaps a gentle mode of existing. They are naturally voracious; and yet they can endure very long abstinence. In the Memoirs of the Academy of Sciences we have the history of a bitch, that having been forgot in a country-house, lived forty days without any other nourishment

than the wool of a mattress, which she had torn to pieces. Water seems to be more necessary to dogs than victuals; for they drink often, and very plentifully: it is even a vulgar opinion, that when they want water too long they become mad. It is also a peculiarity in dogs, that they make great efforts, and seem to suffer much pain, in voiding their excrement. This happens not, as Aristotle alledges, because their intestines become narrower in approaching the anus. On the contrary, it is certain, that in the dog, as in other animals, the great intestines enlarge as they proceed downward, and that the rectum is larger than the colon. The dry temperament of this animal, and not the strangulations of the colon, which are too distant from the rectum, is sufficient to produce this effect.

The shepherd's dog, when transported into Lapland, or other very cold climates, assumes an ugly appearance, and shrinks into a smaller size. But in Russia, Iceland, and Siberia, where the climate is less rigorous, and the people a little more advanced in civilization, he seems to be better accomplished. These changes are occasioned solely by the influence of those climates which produce no great alteration in the figure of this dog; for in each of these climates his ears are erect, his hair thick and long, his aspect wild, and he barks less frequently and in a different manner than in more favourable climates, where he acquires a finer polish. The Iceland dog is the only one that has not his ears entirely erect; for their extremities are a little inclined; and Iceland, of all the northern regions, has been longest inhabited by half civilized men.

The same shepherd's dog, when brought into temperate climates, and among a people perfectly civilized, as Britain, France, Germany, would, by the mere influence of the climate, lose his savage aspect, his erect ears, his rude, thick, long hair, and assume the figure of a bull-dog, the hound, and the Irish greyhound. The bull-dog and Irish greyhound have their ears still partly erect, and very much resemble, both in their manners and sanguinary temper, the dog from which they derive their origin. The hound is farthest removed from the shepherd's dog; for his ears are long and entirely pendulous. The gentleness, docility, and even the timidity of the hound, are proofs of his great degeneration, or rather of the great perfection he has acquired by the long and careful education bestowed on him by man.

The hound, the harrier, and the terrier, constitute but one race; for it has been remarked, that in the same litter, hounds, harriers, and terriers, have been brought forth, though the female hound had been covered by one of these three dogs only. I have joined the common harrier to the Dalmatian dog, or harrier of Bengal, because they differ only in having more or fewer spots on their coat. I have also linked the turnspit, or terrier with crooked legs, with the common terrier; because the defect in the legs of the former has originally proceeded from a disease similar to the rickets, with which some individuals had been affected, and transmitted the deformity to their descendants.

The hound, when transported into Spain and Barbary, where all animals have fine, long, bushy hair, would be converted into the spaniel and water-dog. The great and small spaniel, which differ only in size, when brought into Britain, have changed their white colour into black, and become, by the influence of climate, the great and little King Charles's dog: to these may be joined the Pyrame, which is only a King Charles's dog, black like the others, but marked with red on the four legs, and a spot of the same colour above each eye. and on the muzzle.

The Irish greyhound, transported to the north, is become the great Danish dog; and when carried to the south, was converted into the common greyhound. The largest greyhounds come from the Levant, those of a smaller size from Italy; and those Italian greyhounds carried into Britain have been still farther diminished.

The great Danish dog transported into Ireland, the Ukraine, Tartary, Epirus and Albania, has been changed into the Irish greyhound, which is the largest of all dogs.

The bull-dog, transported from Britain to Denmark, is become the little Danish dog; and the latter, brought into warm climates, has been converted into the Turkish dog. All these races, with their varieties, have been produced by the influence of climate, joined to the effects of shelter, food, and education. The other dogs are not pure races, but have proceeded from the commixtures of those already described.

The greyhound and Irish greyhound have produced the mongrel greyhound, called also the greyhound with wolf's hair. The muzzle of this mongrel is less pointed than that of the true greyhound, which is very rare in France.

The great Danish dog, and the large spaniel, have produced the Calabrian dog, which is a beautiful animal with long bushy hair, and as large as the Irish greyhound.

The spaniel and terrier have produced the dog called *burgos*.

From the spaniel and little Danish dog has proceeded the lion-dog, which is now very rare.

The dogs with long, fine, crisped hair, called the *bouffe* dogs, and which are larger than the water-dog, proceed from the spaniel and water-dog.

The little water-dog comes from the water-dog and small spaniel.

From the bull-dog and Irish greyhound proceeds a mongrel called the mastiff, which is larger than the bull-dog, and resembles the latter more than the Irish greyhound.

The pug-dog proceeds from the bull-dog and small Danish dog.

All these dogs are simple mongrels, and are produced by the commixture of two pure races. But there are other dogs, called double mongrels, because they proceed from the junction of a pure race with a mongrel.

The bastard pug-dog is a double mongrel from a mixture of the pug-dog with the little Danish dog.

The Alicant dog is also a double mongrel, proceeding from the pug-dog and small spaniel.

The Maltese, or lap-dog, is a double mongrel, produced between the small spaniel and little water-dog.

Lastly, there are dogs which may be called triple mongrels, because they are produced by two mixed races. Of this kind are the Artois and Islois dogs, which are produced by the pug-dog and the bastard pug-dog; to which may be added the dogs called street-dogs, which resemble no particular kind, because they proceed from races which have previously been several times mixed.

OF THE VARIETIES OF DOGS.

A few years ago, at the fair of Saint Germain, there was a Siberian dog. It was covered with long hair, hanging almost down to the ground. At first sight it resembled a large lion-dog; but its ears were erect, and much larger. Its colour was all white, and its length, from the nose to the extremity of the body, was 21 inches and a half; and its height behind was 11 inches nine lines, and 11 inches three lines before. The eye was of a brown chesnut colour, and the end of the nose, as well as round the nostrils and mouth, were black. The ears were bushy, of a whitish yellow within, and yellow on the edges and extremities. The long hair of its head partly concealed the eyes, and fell down upon the nose. Its toes and claws were also hid by the hair of its legs. The tail, which turned up like that of the Pomeranian dog, was covered with hair about seven or eight inches long. Of all dogs this is certainly the roughest furred.

Other dogs, brought to Paris by the Russians, which they called Siberian dogs, belonged to a very different race from the preceding. Both male and female were about the size of an ordinary greyhound. The nose was sharp, the ears half erect, but bended a little in the middle. They were not slender like the greyhound, but round and full below the belly. Their tail was about eight or nine inches in length, pretty thick, and obtuse at the extremity. Their colour was black, without any mixture of white hairs; but the female had a gray tuft on the middle of the head, and the male a tuft of the same colour at the end of the tail. They were troublesome with their caresses, and so voracious that they could never be satiated. They were at the same time insufferably dirty, and perpetually roaming about in quest of food. Their legs were tolerably handsome; but their feet were large and broad, and their toes united by a membrane. Their voice was very strong; they had no inclination to bite; they caressed every person indiscriminately; and their vivacity was inexpressible. From this description it appears, that these pretended Siberian dogs are of the same race with that I have called the Iceland dog.

'I have made some inquiry,' says Mr. Collinson, 'concerning the dogs of Siberia. Those which draw 'sleds and carts are of a middle size: their nose is 'sharp, and their ears long and erect. They carry their 'tail bended, some of them like the wolf, and others 'like the fox; and it is certain that they copulate 'with wolves and foxes. I see, from your experiments, 'that when these animals are confined they will not 'intermix; but when at full liberty they willingly come 'together. With regard to the dog and wolf, I myself 'have seen them couple in England. But I have never 'met with any person who saw dogs and foxes inter-'mingle. However, from a kind I saw produced from 'a bitch, which had lived at freedom in the woods, I 'have no doubt that she had been impregnated by a fox. 'The peasants know this species, and distinguish it by 'the name of fox-dogs.'

Most of the Greenland dogs are white; but some of them are black, with very bushy hair. They rather may be said to howl than bark; and they are stupid and unfit for every species of hunting. They serve however for dragging sleds, to which they are yoked by fours and sixes. The Greenlanders eat the dogs flesh, and make garments of his skin.

The dogs of Kamtschatka are rude, and half savage, like their masters. They are commonly black or white, and more nimble and active than our dogs. They are great eaters of fish, and are used for drawing sleds. In summer they have their liberty; but are collected together in the month of October for the purpose of drawing the sleds; and during winter they are fed with a kind of paste composed of fish, which is allowed to ferment in a ditch, and given to them half boiled.

From these facts it appears, that the Greenland and Kamtschatkan dogs, and perhaps those of other northern regions, have a greater resemblance to the Iceland dog than to any of the other races; for the above description of the two Russian dogs, as well as the notices concerning those of Greenland and Kamtschatka, correspond very well, and may be equally applied to our Iceland dog.

Though we have described all the varieties which we could collect, there are still some which could not be procured. For example, there is a race of wild dogs, of which I have seen two individuals, but had not an opportunity of either describing or delineating them. The ingenious and learned M. Aubry, curate of Saint Louis-

has often furnished us with animals of which we had no knowledge. He informs us, that a few years ago, he saw a dog nearly of the size of a spaniel, which had long hair, and a large beard on its chin. This dog was produced from parents of the same race with those which had formerly been sent to Louis XIV. by M. le Comte de Toulouse. M. le Comte de Lassai had also some of these dogs; but I know not what has become of this singular race.

With regard to the wild dogs, among which there are different races, as well as among the domestic kinds, I have little to add to what I have said in my original work. M. le Vicomte de Querhoent has been so obliging as to communicate to me a note with regard to the wild dog found in the environs of the Cape of Good Hope. He remarks, 'That at the Cape there are numerous 'packs of wild dogs, as large as our largest kinds, whose 'skin is marked with various colours. They have erect 'ears, run with great swiftness, and have no fixed resi- 'dence. They destroy an incredible quantity of deer. 'They are seldom slain, and very difficult to take in 'snares; for they have an aversion to approach any 'thing that has been touched by man. As their young 'are sometimes met with in the woods, attempts have 'been made to render them domestic; but they are so 'large, and so ferocious, that these attempts have always 'been abortive.'

THE CAT.

THE cat has six cutting teeth, and two canine in each jaw; five toes before, and four behind; sharp hooked claws, lodged in a sheath that may be exerted or drawn in at pleasure; a round head, short visage, and rough tongue. The wild cat has long soft hair, of a yellowish white colour, mixed with gray; the gray is disposed in streaks, pointing downwards, and rising from a dusky list, which runs from head to tail, along the middle of the back; the tail is marked with alternate bars of black and white, and its tip, and the hind part of the legs, are black. It is three times as large as the domestic cat, and very strongly made.

The cat is an unfaithful domestic, and kept only from the necessity we find of opposing him to other domestics still more incommodious, and which cannot be hunted; for we value not those people, who, being fond of all brutes, foolishly keep cats for their amusement. Though these animals when young are frolicksome and beautiful, they possess at the same time an innate malice, and perverse disposition, which increase as they grow up, and which education learns them to conceal, but not to subdue. From determined robbers, the best education can only convert them into flattering thieves; for they have the same address, subtlety, and desire of plunder. Like thieves, they know how to conceal their steps and their designs, to watch opportunities, to catch the proper moment for laying hold of their prey, to fly from punishment, and to remain at a distance till solicited to return. They easily assume the habits of society, but never acquire its manners; for they have only the appearance of attachment or friendship. This disingenuity of character is betrayed by the obliquity of their movements, and the duplicity of their eyes. They never look their best benefactor in the face; but either from distrust or falseness, they approach him by windings, in order to procure caresses, in which they have no other pleasure than what arises from flattering those who bestow them. Very different from that faithful animal the dog, whose sentiments totally centre in the person and happiness of his master, the cat appears to have no feelings which are not interested, to have no affection that is not conditional, and to carry on no intercourse with men, but with the view of turning it to his own advantage. By these dispositions, the cat has a greater relation to man than to the dog, in whom there is not the smallest mark of insincerity or injustice.

The form and temperament of the cat's body perfectly accord with his temper and dispositions. He is jolly, nimble, dexterous, cleanly, and voluptuous. He loves ease, and chooses the softest and warmest situations for repose. He is likewise extremely amorous, and what is singular in this animal, the female seems to be more ardent than the male. She not only invites and goes in quest of him, but announces by loud cries the fury of her passion, or rather the pressure of her necessities; and when the male disdains her, or flies from her, she pursues, tears, and though their embraces are always accompanied with the most acute pain, compels him to comply with her desires. This passionate ardour of the female continues only nine or ten days, and it happens generally twice a-year, though often thrice, and even four times. The period of gestation is 55 or 56 days, and four or five are commonly produced at a litter. As the male has an inclination to devour the young, the female carefully conceals them; and when apprehensive of a discovery, she takes them up one by one in her

mouth, and hides them in holes, and in inaccessible places. After suckling them a few weeks, she presents them with mice, or young birds, to learn them to eat flesh. But by an unaccountable caprice, these same careful, tender, and affectionate mothers, sometimes assume an unnatural species of cruelty, and devour their own offspring.

Young cats are gay, vivacious, and frolicksome, and if nothing was to be apprehended from their claws, would afford excellent amusement to children. But their toying, though always light and agreeable, is never altogether innocent, and is soon converted into habitual malice. As their talents can only be exerted with advantage against small animals, they lie in wait with great patience and perseverance, to seize birds, mice, and rats, and without any instruction, become more expert hunters than the best trained dogs. Naturally averse to every kind of restraint, they are incapable of any system of education. It is related, however, that the Greek Monks of the island of Cyprus had trained cats to hunt and destroy serpents, with which that island was much infested. But this hunting must rather be ascribed to their general desire of slaughter, than to any kind of tractability or obedience; for they delight in watching, attacking, and destroying all weak animals indiscriminately, as birds, young rabbits, hares, rats, mice, bats, moles, frogs, toads, lizards, and serpents. They have not that docility and fineness of scent, for which the dog is so eminently distinguished. They hunt by the eye only: neither do they properly pursue, but lie in wait, and attack animals by surprise; and after sporting with them, and tormenting them for a long time, they at last kill them without any necessity, and even when well fed, purely to gratify their sanguinary appetite.

The most obvious physical cause of their watching and catching other animals by surprise, proceeds from the advantage they derive from the peculiar structure of their eyes. In man and most other animals, the pupil is capable of a certain degree of contraction and dilatation. It enlarges a little when the light is faint, and contracts when the light is too splendid. But in cats and night birds, as owls, &c. the contraction and dilatation are so great, that the pupil, which is round in the dark, becomes, when exposed to much light, long and narrow like a line. Hence these animals see better in the night than in the day. The pupil of the cat, during the day, is perpetually contracted, and it is only by a great effort that he can see with a strong light. But in the twilight, the pupil resumes its natural roundness, the animal enjoys perfect vision, and takes advantage of this superiority to discover and surprise his prey.

Though cats live in our houses, they are not entirely domestic. Even the tamest cats are not under the smallest subjection, but may rather be said to enjoy perfect liberty; for they act to please themselves only; and it is impossible to retain them a moment after they choose to go off. Besides, most cats are half wild. They know not their masters, and only frequent barns, offices, or kitchens, when pressed with hunger.

Though greater numbers of them are reared than of dogs, as they are seldom seen, their number makes less impression on us. They contract a stronger attachment to our houses than to our persons. When carried to the distance of a league or two, they return of their own accord, probably because they are acquainted with all the retreats of the mice, and all the passages and outlets of the house, and because the labour of returning is less than that which would be necessary to acquire the same knowledge in a new habitation. They have a natural antipathy at water, cold, and bad smells. They are fond of basking in the sun, and of lying in warm places. They are also fond of perfumes, and willingly allow themselves to be taken and caressed by persons who carry aromatic substances. They are so delighted with valerian root, that it seems to throw them into a transport of pleasure. To preserve this plant in our gardens, we are under the necessity of fencing it round with a rail; for the cats smell it at a distance, collect about it in numbers, and by frequently rubbing, and passing and repassing over it, they soon destroy the plant.

Cats require fifteen or eighteen months before they come to their full growth. In less than a year, they are capable of procreating, and retain this faculty during life, which extends not beyond nine or ten years. They are, however, extremely hardy and vivacious, and are more nervous than other animals which live longer.

Cats eat slowly, and with difficulty: their teeth are so short and ill-placed, that they can tear, but not grind their food. Hence they always prefer the most tender victuals, as fishes, which they devour either raw or boiled. They drink frequently; their sleep is light; and they often assume the appearance of sleeping, when they are only meditating mischief. They walk softly, and without making any noise. As their hair is always clean and dry, it is easily electrified, and the sparks become visible when it is rubbed across with the hand in the dark. Their eyes also sparkle in the dark like diamonds, and seem to throw out, in the night, the light they imbibe during the day.

The wild cat couples with the domestic kind; and consequently, they belong to the same species. It is not uncommon to see both males and females quit their houses in the season of love, go to the woods in quest of wild cats, and afterwards return to their former habitations. It is for this reason that some domestic cats so perfectly resemble the wild cat. The only real difference is internal; for the intestines of the domestic cat are commonly much longer than those of the wild cat. The latter, however, is larger and stronger than the domestic kind; his lips are always black; his ears are also stiffer;

his tail larger, and his colours more constant. In this climate there is only one species of wild cat; and it appears from the testimony of travellers, that this kind is found in all climates, without being subject to much variety. They existed in America before its discovery by the Europeans. A hunter brought one of them to Christopher Columbus, which was of an ordinary size, of a brownish gray colour, and having a very long and strong tail. They were likewise found in Peru, though not in a domestic state, and also in Canada, in the country of the Illinois, &c. They have been seen in many places of Africa, as in Guinea and the Gold Coast; at Madagascar, where the natives keep them in a domestic state; and at the Cape of Good Hope, where, M. Kolbe says, there is likewise a wild kind, of a blue colour; but they are not numerous. These blue, or rather slate-coloured cats, are also found in Asia. 'In Persia,' says Pietro della Valle, 'there is a species of cats which properly 'belong to the province of Chorazan. Their figure and 'size are the same with those of the common cat. 'Their beauty consists in the colour of their hair, which 'is gray, and uniformly the same over the whole body, 'except that it is darker on the back and head, and 'clearer on the breast and belly, where it approaches to 'whiteness, with that agreeable mixture of clare-obscure, 'to use the language of painters, which has always a 'wonderful effect. Besides, their hair is fine, shining, 'soft as silk, and so long, that though not frizzled, it 'forms ringlets in some parts, and particularly under 'the throat. These cats are among other cats what the 'water-dog is among other dogs. The most beautiful 'part of the body is the tail, which is very long, and 'covered with hair five or six inches in length. They 'extend and turn it upon their backs, like the squirrel, 'the point resembling a plume of feathers. They are 'very tame; and the Portuguese have brought them 'from Persia into India.' The same author adds, that he had four couple of these cats, which he intended to bring to Italy. From this description it appears, that the Persian cats resemble in colour those we call Chartreux cats, and that, except in colour, they have a perfect resemblance to the cat of Angora. It is probable therefore, that the cat of Chorazan in Persia, the cat of Angora in Syria, and the Chartreux cat, constitute but one race, whose beauty proceeds from the particular influence of the climate, as the Spanish cats, which are red, black, and white, owe their beauty to the climate of Spain. It may be remarked in general, that of all climates on the habitable parts of the globe, those of Spain and Syria are most favourable to the production of beautiful varieties in natural objects. In Spain and Syria the sheep, the goats, the dogs, the cats, the rabbits, &c. have the finest wool, the most beautiful and longest hair, and the most agreeable and variegated colours. These climates, it should appear, soften nature, and embellish the form of all animals.

The wild cat, like most other animals in a savage state, has coarse colours and hard hair. But when rendered domestic, the hair softens, the colours vary; and in the favourable climates of Chorazan and Syria the hair grows long, fine, and bushy; all the colours become more delicate: the black and red change into a shining brown, and the grayish brown is converted into an ash-coloured gray. By comparing the wild cat with the Chartreux cat, it will be found that they differ only in this degradation in the shades of colour. As these animals have always more or less whiteness on their sides and belly, it is apparent, that to produce cats entirely white and with long hair, like the cats of Angora, nothing farther is requisite than to join those who have the greatest quantity of white, as has been done to procure white rabbits, dogs, goats, stags, &c. In the Spanish cat, which is only another variety of the wild kind, the colours, instead of being weakened by uniform shades, as in the cat of Syria, are exalted, and have become more lively and brilliant; the yellow is changed into red, the brown into black, and the gray into white. These cats, though transported into America, have not degenerated, but preserve their beautiful colours. 'In 'the Antilles,' says Father Tertre, 'there are a number 'of cats which have probably been brought from Spain. 'They are mostly marked with red, white, and black. 'Several of our countrymen, after eating the flesh, 'carry the skins of these cats into France. When we 'first arrived at Guadaloupe, the cats were so accustomed 'to feed on partridges, pigeons, thrushes, and other 'small birds, that they disdained the rats; but when 'the game was much diminished, they attacked the rats 'with great fury,' &c. In general, cats are not subject, like dogs, to degeneration, when transported into warm climates. 'The European cats,' Bosman remarks, 'when 'carried to Guinea, change not, like the dogs, but pre-'serve their original figure,' &c. Their nature is indeed more constant; and as their domestic state is neither so complete, so universal, nor perhaps so ancient as that of the dog, it is not surprising that they are also less variegated. Our domestic cats, though they differ in colour, form no distinct races. The climates of Spain and Syria have alone produced permanent varieties: to these may be added the climate of Pe-chi-ly in China, where the cats have long hair and pendulous ears, and are the favourites of the ladies. These domestic cats with pendulous ears, of which we have full descriptions, are still farther removed from the wild and primitive race than those whose ears are erect.

We shall here terminate the history of the cat, and at the same time that of domestic animals. The horse, the ass, the ox, the sheep, the goat, the hog, the dog,

and the cat, are our only domestic animals. We add not to this list the camel, elephant, rein-deer, &c. which, though domestic in other countries, are strangers to us; and we shall not treat of foreign animals till we have given the history of the wild animals which are natives of our own climate. Besides, as the cat may be considered as only half domestic, he forms the shade between domestic and wild animals; for we ought not to rank among domestics those troublesome neighbours, mice, rats, and moles, which, though they inhabit our houses and gardens, are perfectly wild and free. Instead of being attached or submissive to man, they fly from him, and preserve entire, in their obscure retreats, their manners, their habits, and their liberty.

We have seen, in the history of each domestic animal, the great influence which education, shelter, and the careful hand of man, have upon the manners, dispositions, and even the form of animals. We have seen that these causes, joined to the effects of climate, modify and change the species to such a degree as to make them very different from what they are in a natural state, and at the same time introduce such changes among individuals of the same species, that they would be regarded as different animals if they preserved not the faculty of intermixing and producing fertile individuals, which is the only essential characteristic of species. We have seen, that the different races of domestic animals observe in different climates nearly the same order as the races of the human kind; that, like men, they are stronger, larger, and more courageous in cold countries, milder and more civilized in temperate climates, and weaker and more deformed in very warm regions; and that in temperate climates, and among polished people, the varieties of each species are most numerous and diversified, and exhibit the most evident marks of the antiquity of their slavery: pendulous ears, variegated colours, fine long hair, are effects produced by their long continuance in a domestic state. Most wild animals have erect ears. The ears of the wild boar are erect and stiff; but those of the domestic hog are inclined and half pendulous. Among the Laplanders, the savages of America, the Hottentots, the Negroes, and other unpolished people, all the dogs have erect ears; but they are generally soft and pendulous in Spain, France, Britain, Turkey, Persia, China, and other civilized nations. The ears of the domestic cat are not so stiff and erect as those of the wild kind; and in China, a nation which has been very long in a state of civilization, and whose climate is mild, there are cats with pendulous ears. It is for this reason, that the goat of Angora, whose ears are pendulous, should be regarded as a variety farthest removed from the natural state. The strong and marked influence of the climate of Syria, joined to the domestic condition of these animals among a people very anciently civilized, would, in the progress of time, produce this variety, which cannot be preserved in any other climate. In the goats of Angora, brought forth in France, the ears are neither so long nor so pendulous as in those of Syria, and would probably, after a certain number of generations, resume the ears and coarse hair of our common goat.

SUPPLEMENT.

By mistaking some of my expressions in the above history of the cat, I find it has been imagined that I had denied him altogether the power of sleeping. I always knew that cats slept, but not so profoundly as I now find they sometimes do. On this subject M. Pasumot, of the academy of Dijon, an able naturalist, communicated to me a letter, of which the following is an extract.

'Permit me, Sir, to remark, that in your work you 'seem to deny the cat the power of sleeping. I assure 'you, that though he sleeps seldom, his sleep is so pro- 'found that it is a species of lethargy, which I have 'observed at least ten times in different cats. When 'young a favourite cat lay every night in bed at my feet. 'One night I pushed him from me; but I was surprised 'to find him so heavy, and at the same time so immove- 'able, that I believed him to be dead. I pulled him 'smartly with my hand; but I felt no motion. I then 'tossed him about, and by the force of the agitation he 'began slowly to awake. This profound sleep, and dif- 'ficulty of wakening, I have frequently observed. It 'generally happened in the night, having only once ob- 'served it in the day; and this was after perusing what 'you have said concerning the sleep of these animals. 'I know another gentleman who has likewise often seen 'cats sleeping in this profound manner. He tells me, 'that when cats sleep during the day, it is always at the 'time of the greatest heat, and particularly before the 'approach of stormy weather.'

M. de Lestrée, a merchant of Chalons in Champagne, who is accustomed to allow cats to lie in his bed, remarks:

1. 'That when these animals purr, when they are 'tranquil, and appear to be sleeping, they sometimes 'make a long inspiration, which is followed by a strong 'expiration; and that, at this period, their breath has 'an odour which greatly resembles that of musk.

2. 'That when surprised by a dog, or any other ob- 'ject which suddenly alarms them, they make a kind of 'hissing noise, which is accompanied with the same 'odour. This is not peculiar to the males; for I have 'remarked the same thing of both sexes, and of cats of 'all ages and colours.'

From these facts M. de Lestrée seems to think, that

in the breast or stomach of the cat, there are some vessels filled with an aromatic substance, the perfume of which issues from the mouth. But we discover nothing of this kind from anatomy.

I formerly remarked, that in China there were cats with pendulous ears. This variety is not found any where else, and perhaps it is an animal of a different species; for travellers, when mentioning an animal called *sumxu*, which is entirely domestic, say that they can compare it to nothing but the cat, with which it has a great resemblance. Its colour is black or yellow, and its hair very bright and glittering. The Chinese put silver collars about the necks of these animals, and render them extremely familiar. As they are not common, they give a high price, both on account of their beauty, and because they destroy rats.

At Madagascar there are also wild cats rendered domestic. Most of them have twisted tails; and they are called Saca by the natives. But these wild cats are of the same species with the domestic kind; for they intermix and produce.

Another variety has been observed. In our own climate, cats are sometimes produced with pencils of hair at the points of their ears. M. de Seve writes me, (Nov. 16, 1773), that a young cat was brought forth in his house at Paris, of the same race with that we have called the Spanish cat, with pencils at the points of its ears, though neither of the parents had any pencils. In a few months the pencils of this cat were as large, in proportion to its size, as those of the Canadian lynx.

The skin of an animal, which greatly resembles that of our wild cat, has been lately sent me from Cayenne. It is called *haira* in Guiana, where they eat its flesh, which is white and good; and hence we may presume, that however similar to the cat, it belongs to a different species. But perhaps the name *haira* is improperly applied; for it is probably the same with *taira*, which is not a cat, but a small martin, taken notice of hereafter.

OF WILD ANIMALS.

In the history of man, and of domestic animals, we have seen Nature under restraint, seldom perfect, often changed and deformed, and perpetually encompassed with fetters, or loaded with foreign ornaments. She is now to appear naked, and adorned with simplicity alone; but her attractions will be heightened by native beauty, by the freedom of her demeanour, the sprightliness of her movements, and other marks of true dignity and independence. We are to see her traversing the surface of the earth, like a sovereign, dividing her empire among the animals, assigning to each his proper element, climate, and subsistence. We shall survey her in the forests, in the waters, and in the plains, dictating her simple but immutable laws, impressing upon every species indelible characters, dispensing her bounty with equity, compensating evil with good, giving to some strength and courage, accompanied with hunger and voracity; to others gentleness, temperance, and agility, attended with restlessness and timidity; and to all, liberty, uniform manners, and ardour in love, which is always easily gratified, and always followed with a happy fecundity.

Love and liberty are the most inestimable gifts which Nature has to bestow. Do these animals we call wild, because they are not subject to our caprice, require more to render them completely happy? But they also enjoy a perfect equality; they are neither the slaves nor the tyrants of each other. The individual has no occasion, like man, to dread the rest of his species. They have peace among themselves, and war never approaches them, but from strangers, or from man. They have, therefore, great reason to fly from the human race, to conceal themselves from our observation, to take up their abode in solitudes remote from the habitations of men, to provide for their safety by all the resources afforded them by instinct, and to withdraw themselves from the power of man, using, in every manner, that liberty bestowed on them by Nature, at the same time that she has given them the desire of independence.

Some animals, and they are the most gentle, innocent, and tranquil, content themselves with retiring, and passing their lives in our fields. Those which are more fierce and suspicious, hide themselves in the deepest recesses of the forest. Others, as if they knew there was no safety on the surface of the earth, dig subterraneous abodes, take refuge in caverns, or gain the summits of the most inaccessible mountains. Lastly, the most ferocious and formidable kinds, inhabit deserts only, and reign as monarchs in those burning climates, where man, equally savage as themselves, is unable to conquer them.

As all beings, however free, are subjected to physical

laws; and as the brute animals, as well as man, feel the influences of the heavens and the earth, it appears, that the same causes which have softened and civilized the human species in our climates, have produced similar effects upon every other species. The wolf, which is perhaps the most ferocious animal in the Temperate Zone, is not nearly so terrible or so cruel as the tiger, the panther, and the lion of the Torrid Zone, or the white bear, the lynx, and the hyæna of the Frozen Zone. This difference, as if Nature, to give more harmony to her productions, had adapted the climate to the species, or the species to the climate, is not only general, but in each particular species, the climate is formed for the manners, and the manners for the climate.

In America, where the heat under the same latitudes is less, and the air and earth softer than in Africa, the tiger, the lion, the panther, have nothing formidable in them but the name. They are no longer those tyrants of the forest, those bold and intrepid enemies of man, those rapacious monsters which perpetually thirst for blood and carnage. These animals, in America, generally fly from man, and attack not other wild beasts with open force, but lie in wait to surprise them: they may even be subdued, and almost tamed. Hence if ferociousness and cruelty were natural to them, they must have degenerated, or rather felt the influence of climate. Under a mild climate, their nature has been softened; every excess of temper has been moderated; and these changes have only rendered them more conformable to the quality of the country they inhabit.

The vegetables which cover the earth, and are more closely connected with it than the animal that feeds upon them, participate also more of the nature of the climate. Every country, every degree of temperature, has its peculiar plants. At the foot of the Alps, we find the vegetables of France and Italy, and on their summit, those of the northern regions: we even meet with the same plants on the frozen ridges of the African mountains. On the south side of the mountains which divide the Mogul empire from the kingdom of Cashmire, we see all the Indian plants, and we are surprised to find, on the opposite side, nothing but the European kinds. Intemperate climates likewise produce drugs, perfumes, poisons, and all vegetables whose juices are highly exalted. The productions of temperate climates, on the contrary, are always mild: the softest and most wholesome herbs, the sweetest fruits, the gentlest animals, and the most polished men, are peculiar to those happy climates. Thus the earth produces plants, the earth and plants make animals, and the earth, plants, and animals, give birth to man; for the qualities of vegetables proceed immediately from the earth and the air; the temperature and other relative qualities of herbivorous animals are derived from the plants upon which they feed; and the physical qualities of man, and other creatures which are nourished partly by flesh and partly by plants, depend, though more remotely, on the same causes, whose influence extends even to dispositions and manners. Figure and size, which appear to be absolute and determined qualities, depend, however, like the relative qualities, upon the influence of climate, and concur in proving that every thing is moderate in temperate regions. The size of our largest quadrupeds have no proportion to that of the elephant, the rhinoceros, or hippopotamus. Our largest birds are small, when compared with the ostrich, the condor, or the cassawary; and what comparison is there between the fishes, the lizards, and the serpents of our climates, with the whale, the walrus, and manati, which people the northern seas, or the crocodiles, the large lizards, and the enormous serpents which infest the land and waters of the south? And if we examine each species in different climates, we shall find sensible varieties both in size and figure. These changes are produced in a slow and imperceptible manner. Time is the great workman of Nature. He moves with regular and uniform steps. He performs no operation suddenly; but by degrees, or successive impressions, nothing can resist his power; and those changes which at first are imperceptible, become gradually sensible, and at last are marked by results too conspicuous to be misapprehended.

Wild and free animals, without excepting man, are of all animated beings, least subject to changes or variations of any kind. As they are at absolute liberty in the choice of their food and their climate, their nature is more permanent than that of domestic animals, which are enslaved, transported, maltreated, and fed, without consulting their inclination or taste. Wild animals live perpetually in the same manner. They never wander from climate to climate. The wood where they are brought forth is a country to which they are faithfully attached, and they never depart from it, unless they perceive that they can no longer live there in safety. They fly not so much from their natural enemies, as from the presence of man. Nature has furnished them with resources against the other animals, and put them on a level; they know their strength, their address, their designs, their haunts, and if unable to avoid them, oppose force to force: in a word, they are species of the same genus. But how can they defend themselves against a being who is able to seize without seeing, and kill without approaching them?

It is man, therefore, who disturbs and disperses wild animals, and renders them a thousand times more savage than they would naturally be; for most of them require tranquillity only, and a moderate use of the air and earth. Nature even teaches them to live together, to unite into families, and to form societies. In countries not totally engrossed by man, some vestiges of these societies still remain. We there perceive common works

carried on, designs that, though not founded on reason, appear to be projected upon rational conventions, the execution of which supposes union at least, and a joint co-operation of labour. It is not by force or physical necessity, like the ants, the bees, &c. that the beavers labour and build houses; for they are neither constrained by space, nor time, nor number, but unite from choice. Those which agree, dwell together; and those which do not agree, remove; and some of them have been remarked, which, being constantly repulsed by others, were obliged to betake themselves to a solitary life. It is only in distant and desert countries, where they dread not the approach of man, that they incline to render their dwellings more fixed and commodious, by constructing houses, or a kind of villages, which have no small resemblance to the feeble and primitive efforts of a nascent republic. In countries, on the contrary, spread over by men, they carry terror along with them. The society of animals is then at an end. All industry ceases, and every art is stifled. They think no more of building, and neglect every conveniency. Perpetually pressed by fear and necessity, their only desire is the bare preservation of life, and their only occupation is flight and concealment. If the human species, as is reasonable to suppose, shall in the progress of time, people equally the whole surface of the earth, the history of the beaver, in a few ages, will be regarded as a ridiculous fable.

We may therefore conclude, that the talents and faculties of animals, instead of augmenting, are perpetually diminishing. Time fights against them. The more the human species multiplies and improves, the more will the wild animals feel the effects of a terrible and absolute tyrant, who, hardly allowing them an individual existence, deprives them of liberty, of every associating principle, and destroys the very rudiments of their intelligence. What advances they have made, or may still make, convey little information of what they have been, or might acquire. If the human species were annihilated, to which of the animals would the sceptre of the earth belong?

THE STAG, OR RED DEER.

THE deer kind have upright, solid, branched horns, which annually fall off; eight cutting teeth in the lower jaw, and none in the upper. The stag has long, upright, rounded, and much branched horns: the brow antlers are slender and sharp. The colour of the stag is generally a reddish brown, with some black about the face, and a black list runs down the hind part of the neck and between the shoulders. It grows to a large size; one killed in the county of Aberdeen weighed 18 stone Scottish weight, or 314 lb. The horns of the American stag sometimes weigh 30 lb. and are about four feet high.

The stag is one of those innocent, gentle, and peaceable animals, which seem to be destined to embellish and animate the solitudes of the forest, and to occupy, at a distance from man, the tranquil retreats of those gardens of Nature. The elegance and lightness of his figure, the commodiousness of his stature, the flexibility and springiness of his limbs, his grandeur, strength, and swiftness, and his head, which is rather adorned than armed with living branches, that like the leaves of trees, are annually renewed, sufficiently distinguish him from the other inhabitants of the wood. As he is also the noblest of these animals, he ministers to the pleasure, and has occupied the leisure, of the greatest heroes. The exercise of the chase should always succeed, or rather precede, the fatigues of war. To know the management of horses and arms, are talents common to the warrior and the hunter. To be accustomed to fatigue, address, dexterity, and quickness of movement, so necessary for the support of courage, are qualities acquired in the chase, and extremely useful in battle. Hunting is a most delightful school of a necessary art. It is the only amusement which entirely divests us of care, the only recreation that is not accompanied with effeminacy, and gives vivacity and pleasure, without languor or disgust.

How can men, who from their situation in life are perpetually harassed with company, be better employed than in hunting? Always surrounded with a multitude, teased with the importunity of their demands, obliged to give their attention to affairs which are foreign to them, agitated by the solicitations of men of high rank, and constrained and fettered in proportion to their elevation, great men would feel only the weight of their own grandeur, and exist only for others, if they did not occasionally abstract themselves from a crowd of parasites and flatterers. To preserve self-enjoyment, to recal personal attachments, and receive private friendship, sentiments a thousand times more precious and

interesting than all the ideas of grandeur, retirement from the tumult and business of the world is sometimes necessary; and what retirement can be more various and animated than the chase? what exercise more useful to the body? what amusement more agreeable to the mind?

Perpetual action, or intercourse with man, is equally painful as perpetual thinking. Nature never intended man for the contemplation of abstract subjects. To be occupied, without relaxation, in difficult studies, to lead a sedentary life, and to make the closet the centre of our existence, is equally unnatural as to pass our days in tumult and agitation, continually drawn along by the movements of other men, and obliged to keep a jealous and constrained watch over our own conduct, looks, and gestures. Whatever ideas we may conceive of the dignity of human nature, it is apparent, that public exhibition is not existence, and that we are less fitted for thinking than for action; for reasoning than enjoyment. True pleasure consists in the unrestrained use of ourselves. Our best gifts are those we receive from Nature. She presents us with the useful and inexhaustible enjoyments which arise from the air, the earth, the fields, and the forests. Hence a taste for hunting, fishing, gardening, and agriculture, is natural to all men: and in societies less complicated than ours, there are only two ranks, both of them connected with this mode of life; the Nobles, whose business is arms and hunting; and the Vulgar, who are occupied in cultivating the earth.

In polished societies, where every thing is improved and brought nearer perfection, to render hunting more delightful and sprightly, to ennoble this most beneficial and respectable of all exercises, it has been formed into an art. The chase of the stag requires a species of knowledge, which can only be learned by experience: it implies a royal assemblage of men, horses, and dogs, all so trained, practised, and disciplined, that their movements, their researches, and their skill, must concur in producing one common end. The huntsman should know the age and the sex of the animal; he should be able to distinguish with precision, whether the stag he has *harboured* with his hound be a *knobber*, a young stag, in his sixth or seventh year, or an old stag. The chief marks which convey this intelligence is derived from the *foot*, and the excrement. The *foot* of the stag is better formed than that of the hind, or female. Her *leg* is more gross and nearer the heel. The impressions of his feet are rounder, and farther removed from each other. He moves more regularly, and brings the hind foot into the impression made by the fore foot. But the distance between the steps of the hind are shorter, and her hind feet strike not so regularly the track of the fore feet. As soon as the stag acquires his fourth horns, he is easily distinguished; but to know the *foot* of a young stag from that of a hind, requires repeated experience. Stags of six, seven, &c. years, are still more easily known; for their fore foot is much larger than the hind foot; the older they are, the sides of their feet are the more worn; the distance of their steps are more regular than those of young stags; they always place their hind foot exactly in the track of the fore foot, except, when they shed their horns, the old stags *misplace*, at this season, nearly as often as the young ones; but in this they are more regular than the hind or young stag, placing the hind food always at the side of the fore foot, and never beyond or within it.

When the huntsman, from the dryness of the season, or other circumstances, cannot judge by the foot, he is obliged to trace the animal backwards, and endeavour to find his dung. This mark requires, perhaps, greater experience than the knowledge of the foot; but without it, the huntsman would be unable to give a proper report to the company. After the report of the huntsman, and the dogs are led to the refuge of the stag, he ought to encourage his hound, and make him rest upon the track of the stag till the animal be unharboured. Instantly the alarm is given to uncouple the dogs, which ought to be enlivened by the voice and the horn of the huntsman. He should also diligently observe the foot of the stag, in order to discover whether the animal has started, and substituted another in his place. But it is then the business of the hunters to separate also, and to recal the dogs which have gone astray after false game. The huntsman should always accompany his dogs, and encourage, without pressing them too hard. He should assist them in detecting all the arts of escape used by the stag; for this animal has remarkable address in deceiving the dogs. With this view, he often returns twice or thrice upon his former steps; he endeavours to raise hinds or younger stags to accompany him, and draw off the dogs from the object of their pursuit: he then flies with redoubled speed, or springs off at a side, lies down on his belly, and conceals himself. In this case, when the dogs have lost his foot, the huntsmen, by going backwards and forwards, assist them in recovering it. But if they cannot find it, they suppose that he is resting within the circuit they have made, and go in quest of him. But if they are still unable to discover him, there is no other method left, but from viewing the country, to conjecture where he may have taken refuge, and repair to the place. As soon as they have recovered his foot, and put the dogs upon the track, they pursue with more advantage, because they perceive that the stag is fatigued. Their ardour augments in proportion to his feebleness; and their scent becomes more distinct as the animal grows warm. Hence they redouble their cries and their speed; and though the stag practises still more arts of escape than formerly, as his swiftness is diminished, his arts and doublings become gradually

less effectual. He has now no other resource but to fly from the earth which he treads, and get into the waters, in order to cut off the scent from the dogs. The huntsmen go round these waters, and again put the dogs on the track of his foot. The stag, after taking to the water, is incapable of running far, and is soon *at bay*. But he still attempts to defend his life, and often wounds the dogs, and even the huntsmen when too forward, by blows with his horns, till one of them cuts his hams to make him fall, and then puts an end to his life by a blow of a hanger. They now celebrate the death of the stag by a flourish of their horns; the dogs are allowed to trample upon him, and at last partake richly of the victory by devouring his flesh.

Every season is not equally proper for hunting the stag with hounds. In spring, when the leaves begin to unfold and to adorn the forests, when the earth is covered with fresh herbage and flowers, their perfumes diminish the sensation of the dogs; and as the stag is then in his greatest vigour, it is extremely difficult for them to come up with him. It is likewise a settled point among hunters, that when the hinds are about to bring forth the chase is most difficult, and that, at this period, the dogs often quit a fatigued stag, and pursue any hind which bounds before them. In the same manner, in the beginning of autumn, when the rutting season commences, the hounds hunt without ardour: the strong odour of love renders perhaps the scent more uninteresting; and perhaps at this season the odour of all stags is nearly the same. During the winter snows it is also improper to hunt the stag; because the hounds have no acuteness of scent, and seem to pursue the foot rather by the eye than the nose. As in this season the stags find not sufficient nourishment in their retreats, they issue forth into the more open parts of the country, and even into the sown fields. They assemble in flocks in the month of December, and when the frosts are severe they seek shelter on the sea-coasts or in covered places, where they lock themselves fast together, and acquire warmth by mutual respiration. When the rigours of winter decline, they frequent the borders of the forest, and make depredations on the rising wheat. In spring they shed their horns, which fall off spontaneously, or by rubbing them gently against the branches of trees. It is seldom that both horns fall off at the same time, the one generally preceding the other a day or two. The old stags cast their horns first, which happens about the end of February or beginning of March. An aged stag, or one in his seventh year or upwards, does not cast his horns before the middle of March; a stag of six years sheds his horns in April; young stags, or those from three to five years old, shed their horns in the beginning, and those which are in the second year not till the middle or end of May. But in all this there is much variety; for old stags sometimes cast their horns sooner than those which are younger. Besides, the shedding of the horns is advanced by a mild, and retarded by a severe and long winter.

As soon as the stags cast their horns, they separate from each other, the young ones only keeping together. They no longer haunt the deepest recesses of the forest, but advance into the cultivated country, and remain among brushwood during the summer, till their horns are renewed. In this season they walk with their heads low to prevent their horns from rubbing against the branches; for they continue to have sensibility till they acquire their full growth. The horns of the oldest stags are not half completed in the middle of May, and acquire their full length and hardness before the end of July. Those of the younger stags are proportionally later, both in shedding and being renewed. But as soon as they have acquired their full dimensions and solidity, the stags rub them against the trees, in order to clear them of a skin with which they are covered; and as they continue this friction for several days successively, it is said, that the horns retain the colour peculiar to the juices of the trees against which they have been rubbed; that they become red when rubbed against beeches and birches, brown against oaks, and black against elms and trembling poplars. It is likewise said, that the horns of young stags, which are smoother, take not so deep a tincture from the trees as those of old stags, which are rougher, and closer covered with little prominences; because it is these prominences which retain the coloured juices of the trees. But I cannot believe that this is the true cause; for I have kept tamed stags in an inclosure where there was not a single tree, and yet their horns were coloured in the same manner as in those which inhabit the forests.

Soon after the stags have polished their horns they begin to feel the impressions of love. Towards the end of August, or beginning of September, they leave the coppice, return to the forests, and search for the hinds. They cry with a loud voice; their neck and throat swell, they become perfectly restless, and traverse in open day the fields and the fallow grounds; they strike their horns against trees and hedges; in a word, they seem to be transported with fury, and run from country to country till they find the hinds or females, whom they pursue and compel into compliance; for the female at first avoids and flies from the male, and never submits to his embraces till she be fatigued with the pursuit. The old hinds likewise come in season before the younger ones. When two stags approach the same hind, they must fight before they enjoy. If nearly equal in strength they threaten, paw the ground, set up terrible cries, and attack each other with such fury that they often inflict mortal wounds with the strokes of their horns. The combat never terminates but in the defeat or flight of one of the rivals. The conqueror loses not

a moment in enjoying his victory, unless another rival approaches, whom he is again obliged to attack and repel. The oldest stags are always masters of the field; because they are stronger and more furious than the young ones, who must wait patiently till their superiors tire, and quit their mistresses. Sometimes, however, the young stags accomplish their purposes when the old ones are fighting, and after a hasty gratification fly off. The hinds prefer the old stags, not because they are most courageous, but because they are much more ardent. They are likewise more inconstant, having often several females at a time; and when a stag has but one hind, his attachment to her does not continue above a few days: he then leaves her, goes in quest of another, with whom he remains a still shorter time; and in this manner passes from one to another, till he is perfectly exhausted.

This ardour of love lasts only three weeks, during which the stags take very little food, and neither sleep nor rest. Night and day, they are either walking, running, fighting, or enjoying the hinds. Hence, at the end of the rutting season, they are so meagre and exhausted, that they recover not their strength for a considerable time. They generally retire to the borders of the forests, feed upon the cultivated fields, where they find plenty of nourishment, and remain there till their strength is re-established. The rutting season of old stags commences about the beginning, and ends about the 20th day of September. In those of six or seven years old, it begins about the tenth of September, and concludes in the beginning of October. In young stags, or those in their third, fourth, or fifth year, it begins about the 20th of September, and terminates about the 15th of October; and at the end of October, the rutting is all over, except among the prickets, or those which have entered into their second year; because they, like the young hinds, are latest of coming into season. Hence, at the beginning of November, the season of love is entirely finished; and the stags, during this period of weakness and lassitude, are easily hunted down. In seasons when acorns and other nuts are plentiful, the stags soon recover their strength, and a second rutting frequently happens at the end of October; but it is of much shorter duration than the first.

In climates warmer than that of France, the rutting time, like the seasons, is more forward. Aristotle informs us, that in Greece, it commences in the beginning of August, and terminates about the end of September. The hinds go with young eight months and some days, and seldom produce more than one fawn. They bring forth in May or the beginning of June, and so anxiously conceal their fawns, that they often expose themselves to be chased, with a view to draw off the dogs, and afterwards return to take care of their young. All hinds are not fertile; for some of them never conceive. These barren hinds are grosser and fatter than those which are prolific, and also come soonest in season. Some hinds are said to have horns like the stag, which is not altogether improbable. The young are not called fawns or calves after the sixth month: the knobs of their horns then begin to appear, and they take the name of *knobbers* till their horns lengthen into spears, and then they are called *brocks* or *staggards*. During the first season, they never leave their mothers. In winter, the stags and hinds, of all ages, keep together in flocks, which are always more numerous in proportion to the rigour of the season. They separate in spring: the hinds retire to bring forth; and during this period, the flocks consist only of knobbers and young stags. In general the stags are inclined to associate, and nothing but fear or necessity obliges them to disperse. The stag is capable of generating at the age of eighteen months: those brought forth during the spring of the preceding year, cover the hinds in autumn; and it is presumeable that these embraces are prolific. The following circumstances, however, may render this opinion doubtful: the stags have not then acquired above a half or two thirds of their growth, which is not completed till the eighth year of their age; and their horns continue to increase during the same period. But it ought to be remarked, that the fawn soon gathers strength; that during the first, and even the second year, his growth is very quick; and that he has already a redundance of nourishment, because his horns are considerably long, which is the most certain mark of ability to impregnate. It is allowed that animals in general are not capable of procreating, till they have nearly acquired their full growth. But those which have fixed seasons for rutting or spawning, seem not to observe this law. Fishes spawn and are prolific before they have attained a fourth, or even an eighth part of their growth; and among quadrupeds, those which, like the deer-kind, have determined seasons for rutting, procreate earlier than other animals.

There are so many relations between the nutrition, the production of the horns, the rutting, and the generation of these animals, that to have a clear conception of the particular effects which result from them, it is necessary to give a general recapitulation of what I formerly advanced on the subject of reproduction. Generation depends solely on a redundance of nourishment. During the growth of an animal, which is always most rapid in infancy, the nourishment is entirely exhausted in the extension and developement of the body. Hence there is no redundance, consequently no production or secretion of seminal fluid, and of course, young animals are incapable of procreation. But when they have obtained the greatest part of their growth, the redundance of nourishment begins to manifest itself by new productions. In man, the beard, the hair, the prominency of the breasts, and the expansion of the organs of gene-

ration, appear at the age of puberty. In the brute creation, and particularly in the stag, this redundance produces effects still more remarkable, as the growth of the horns, the swelling of the testicles, the turgidity of the neck and throat, the fat, the rutting, &c. And as the growth of the stag is at first very rapid, a year only passes before the redundance of nourishment begins to show itself by the production of horns: if brought forth in May, the rudiments of the horns appear in the same month of the following year; and they continue to lengthen and acquire solidity, in proportion to the quantity of nourishment taken by the animal. About the end of August, they are fully grown, and so dense and insensible, that the animal rubs them against the trees, in order to deprive them of the skin or scurf with which they are covered. At the same time, the fat, which is likewise produced by the redundance of nourishment, ceases to accumulate, and begins to be determined towards the organs of generation, and to excite in the stag that ardour of desire which renders him perfectly furious. That the production of horns, and the secretion of semen, depend on the same cause, is evident from this fact, that when the organs necessary for the secretion of semen are destroyed by castration, the production of the horns is likewise prevented; for if this operation is performed after the horns are shed, they are never renewed; and if on the contrary, it is done when the horns are perfect, they never fall off. In a word, after castration, the animal remains during life in the same condition it was before that operation. As it feels no longer the ardour of rutting, the concomitant symptoms likewise disappear. There is no longer any accumulation of fat or suet, no more turgidity of the neck and throat, and the disposition of the creature becomes more gentle and tranquil. The parts cut off, therefore, were necessary, not only for collecting the redundant nourishment, but likewise for pushing it to the surface of the body in the form of fat, and particularly to the top of the head, where it gives rise to the horns, and for giving vigour and spirit to the animal. Castrated stags, it is true, become fat; but they produce no horns; their neck and throat never swell; and their fat is never so highly exalted as that of entire stags, which in the rutting season have an odour so strong as to be perceived at a great distance; and their flesh is so infected with it, that it is uneatable, offensive to the smell, and putrifies in a very short time; while that of the castrated stag may be preserved fresh, and eat at all seasons. The difference between the horns of stags of the same age, of which some are thick, and others thin and slender, which is entirely owing to a defect of food, is another proof that the horns are produced by redundant nourishment; for a stag which inhabits a rich country, where required, not disturbed by dogs or men, but is allowed to feed and ruminate in peace, will always have the highest, widest, largest, and most branchy horns. But those which live in situations where they can neither find repose nor a sufficient quantity of food, will have horns with few branches, slender stems and brow-antlers. Thus it is easy to judge by the horns of the stag, whether he has lived in a rich and peaceable country, or the opposite. Those which are in a bad condition, have been wounded, or much disturbed by hunting, are seldom fat, or have fine horns; their rutting time is also later; and their horns are neither so soon shed nor renewed. Hence every circumstance concurs in demonstrating that the horns, like the seminal fluid, are nothing but the redundant and superfluous organic nourishment, which could not be exhausted in expanding and supporting the animal body.

It is therefore apparent, that penury of food both retards the growth and diminishes the size of the horns; and perhaps it is not impossible, by retrenching the quantity of food, to suppress entirely this production, without having recourse to castration. It is, however, certain, that castrated stags eat less food than those which are unmutilated; and the females of this species, as well as those of the fallow-deer, the roe, and the elk have no horns, because they eat less than the males; and because, at the very time that a redundance of nourishment would naturally happen, they are with young, and instead of showing itself externally, it is first exhausted in nourishing the fœtus, and afterwards in nourishing the fawn. The objection, that the female rein-deer, which has horns like the male, rather supports than weakens this argument; for of all horned animals, the rein-deer, in proportion to his size, has the largest and most voluminous horns, often extending, before and behind, the whole length of the body. He likewise abounds most in fat; and besides, the horns of the female are much smaller than those of the male. This example, therefore, proves no more than that, when the redundance is so great as not to be exhausted by gestation and the growth of the fœtus, it breaks through the body, and forms a new production, as in the male, only smaller in size, because the quantity of redundant matter is less.

What I have remarked concerning nourishment ought not to be extended to the mass or volume of the aliments, but only to the quantity of organic particles, that living, active, and prolific matter, which unfolds and supports all animated beings. The rest is nothing but dregs, which may be more or less in quantity, without inducing any change upon the body: and as the *lichen rangiferinus*, or rein-deer liverwort, is the ordinary food of the rein-deer, and is more substantial than the leaves, the bark, or the buds of trees, it is not surprising, that this animal should have a greater redundance of organic particles, and consequently, larger horns, and more fat, than the common stag. It must be acknowledged,

however, that the organic matter which produces the horns, is not perfectly disengaged from useless particles, and that it preserves, after passing the body of the animal, marks of its former vegetable state. The horns of the stag shoot, grow, and are disposed like the branches of a tree. Its substance is perhaps less osseous than lignous. To use the expression, it is a vegetable grafted upon an animal, participating of the nature of both, and forming one of those shades by which Nature always bounds the extremities of her productions, and which she employs to connect substances that are greatly removed from each other.

In the animal, as formerly remarked, both extremities of the bones grow at a time. The fulcrum upon which the extending power is exerted, is in the middle of the bone, which part is always first ossified, and from which the two extremes progressively recede, and continue soft till the bone acquires its full length. In the vegetable, on the contrary, only one extremity of the wood grows. The bud which unfolds to form a branch, is attached to the old wood by its inferior extremity, and upon this fulcrum the power of longitudinal extension acts. This remarkable difference between the vegetation of bones and the solid parts of plants, does not take place in the horns of stags. On the contrary, nothing can be more similar to the growth of a tree. The horns extend at one extremity only, the other serving for a fulcrum. They are at first tender as an herb, and then harden like wood. The skin which covers and grows along with them is their bark, and it is rubbed off after they attain their full size. As long as they continue to grow, their extremities are soft; and they likewise divide into several branches. In a word, every circumstance is similar, and corresponds in the developement of both. Hence the organic particles, which constitute the living substance of the stag, still retain the impression of the vegetable; because they arrange themselves in the same order as the parts of plants. Here it is apparent, that matter has an influence upon form. The stag which inhabits the forest, and feeds on the sprigs of trees only, takes so strong an impression from the wood, that he produces a species of tree, which preserves indelible and evident marks of its origin. This effect, though singular, is not solitary, and depends on a general cause, which I have already pointed out.

Both in animals and vegetables, the character or mould of each species, is the most constant and unalterable thing in Nature: what is most variable and desultory, is the matter of which they are composed. Matter in general seems to be indifferent to all forms, and capable of receiving every possible impression. The organic or living particles of this matter pass from vegetables to animals, without destruction or alteration, and form equally the living substance of the herb, of the wood, of the flesh, and of the bones. According to this view, it appears that matter can never have any influence on form, and that no kind of food, provided the animal can extract the organic particles, and assimilate them by nutrition, could induce any change upon the form, or have any other effect than to support and expand the body, by modelling itself upon all the particles of the interior mould, and intimately penetrating them. What proves this point is, that animals which live upon herbage, a substance very different from that of their own bodies, extract from it materials sufficient for the production of flesh and blood, and that they are nourished and grow as well as animals who feed upon flesh alone. However, by examining Nature more minutely, we shall find, that the organic particles sometimes do not perfectly assimilate themselves to the internal mould, and that matter has often a sensible influence upon form. Size, for example, which is one of the attributes of form, varies in every species, according to the difference of climate. The quality and quantity of flesh, two other attributes of form, change according to the difference of food. This organic matter, therefore, which the animal assimilates to its own body by nutrition, is not absolutely indifferent to the reception of every form, nor deprived of the original figure which it possessed. It retains some characters of its primitive state. It acts, therefore, by its proper form upon that of the organized body to which it affords nourishment; and though this action is almost imperceptible, and infinitely inferior to the power which obliges the organic particles to assimilate themselves to the internal mould that receives them, yet in the progress of time, sensible effects must result from it. The stag, who inhabits the forests, and lives solely upon wood, produces and carries about with him a species of trees, which is nothing but the redundant part of his nourishment. The beaver, who lives in the waters, and feeds upon fishes, has a tail covered with scales. The flesh of the otter, and of most waterfowls, is a Lent diet, a kind of fishy flesh. We may, therefore, presume that animals perpetually nourished by the same food, however strong the original impression of Nature, would, in process of time, acquire a tincture from the qualities of this food, and undergo a kind of transformation, by an assimilation contrary to the first. The nourishment would no longer assimilate itself entirely to the form of the animal, but the animal would partly assimilate itself to the form of nourishment, as we perceive in the horns of the stag and the tail of the beaver.

In the stag, the horns are an accessory, a part foreign to the animal, and regarded as belonging to him only because it proceeds from his body. But it is really a vegetable production, since it retains the characters of that vegetable from which it derives its origin, and resembles the wood of trees, in the manner of ramification, solidity, drying, and separation; for although

acquiring its greatest density, it ceases to extract nourishment, it falls spontaneously, like a ripe fruit from the branch. The very name given to this production in our language is an indication that it has been regarded as wood, and not as a horn, a bone, a tusk, &c. And though this theory seems to be sufficiently established by the preceding reasoning, yet I ought not to pass over a fact recorded by the ancients. Aristotle, Theophrastus, and Pliny tell us, that ivy has been seen growing round the young horns of stags. If this fact be true, and it may easily be determined by experiment, an analogy still more intimate will be established between the wood of the stag and that of trees.

The horns and tusks of other animals are not only different from the *wood* of the stag; but in their growth, texture, and form, both external and internal, there is nothing analogous to wood. The nails, the claws, the hairs, the feathers, the scales of animals, grow, it is admitted, by a species of vegetation; but this vegetation differs widely from that of wood. The horns of oxen, goats, antelopes, &c. are hollow within; but the wood of the stag is equally solid through its whole extent. The substance of these horns is the same with that of the nails, claws, and scales: but the horns of the stag resemble wood more than any other substance. The inside of all hollow horns is covered with a kind of *periosteum*, and they contain in their cavity a bone or core which supports them; they never shed, but grow during the life of the animal; and its age may be learned by their rings or annual circles. Instead of growing by their superior extremity, like the wood of the stag, they grow like nails, feathers, and hairs, by their inferior extremity. In the same manner, the tusks of the elephant, walrus, and wild boar, and all other animals, are hollow within, and grow only by their inferior extremity. Thus horns and tusks have no more analogy to the wood of the stag than nails, hairs, or feathers.

Vegetation may therefore be reduced to three kinds. The first, in which the growth proceeds from the superior extremity, as in plants, trees, and the wood of the stag; the second, where the growth advances from the inferior extremity, as in horns, nails, claws, hairs, feathers, scales, tusks, teeth, and other external parts of animal bodies; the third, in which the growth proceeds from both extremities at the same time, as in bones, cartilages, muscles, tendons, and other internal parts of animals. The material cause of all these three species is the redundance of organic nourishment; and the assimilation of this nourishment by the internal mould, which receives it, is the effect. Thus the growth of an animal is always more or less rapid, in proportion to the quantity of this redundant nourishment; and after the greatest part of growth is acquired, it is determined to the seminal reservoirs, endeavours to escape from the body, and to produce, by means of copulation, new organized beings. The difference between animals, which, like the stag, have fixed seasons, and other animals which can engender at all times, proceeds entirely from their manner of feeding. Man and domestic animals, who have daily an equal quantity of food, and often too much, are perpetually in a capacity for procreation. The stag, on the contrary, and most wild animals, who suffer greatly in the winter for want of food, have then nothing redundant, and are incapable of generating till they recruit during the summer. It is immediately after this season that the stag begins to rut; and by the great waste he suffers at this period, he continues during winter in a state of languor and debility. His flesh is then so meagre, and his blood so impoverished, that worms breed under his skin, which still augment his misery, and he does not get quit of them till the spring, when he acquires new life and vigour by the active nourishment furnished to him by the fresh productions of the earth.

Thus the life of the stag is spent in alternate plenty and want, vigour and debility, health and sickness, without having any change introduced into his constitution by these opposite extremes. He lives as long as other animals which are not subject to such vicissitudes. As he grows five or six years, he lives seven times that number, or from 35 to 40 years. What has been reported concerning the longevity of the stag merits no credit. It is only a popular prejudice which prevailed in the days of Aristotle, and which that philosopher considered as improbable, because neither the time of gestation, nor of the growth of the young stag, indicated long life. This authority ought to have abolished the prejudice; but it has been renewed, in the ages of ignorance, by a fabulous account of a stag taken by Charles VI. in the forest of Senlis, with a collar upon which was written this inscripton, *Cæsar hoc me donavit*. The love of the marvellous inclined men to believe that this animal had lived a thousand years, and had his collar from a Roman emperor, rather than to suppose that he came from Germany, where all the emperors take the name of *Cæsar*.

The horns of the stag augment annually both in height and thickness, from the second to the eighth year, and continue nearly in equal beauty during all the vigour of life. But when he grows old his horns decline. Our stags have seldom more than twenty or twenty-two antlers or palms; and this number, even when at the highest pitch of vigour and perfection, is by no means constant; for it varies every year, according to the quantity of nourishment and repose the animal has enjoyed: the largeness of the horns depends on the same cause; and their quality is also determined

by the kind of nourishment they receive. Like the wood of the forest, the wood of the stag is large, tender, and light, in moist and fertile countries, and short, hard, and heavy, in dry and barren regions.

The size and stature of the animals themselves likewise differ according to the places they inhabit. The stags which frequent the valleys, or hills abounding in grain, are larger and taller than those which feed upon dry and rocky mountains. The latter are low, thick, and short. Neither are they equally swift; but they run longer than the former: they are also more vicious, and have longer hair on their heads. Their horns are commonly short and black, like a stunted tree, the bark of which is always of a darker colour. But the horns of the stags which feed in the plains are high, and of a clear reddish colour, like the wood and bark of trees which grow in a good soil. These little squat stags never frequent the lofty woods, but keep always among the coppices, where they can more easily elude the pursuit of the dogs. The Corsican appears to be the smallest of these mountain-stags. He exceeds not the half of the height of the ordinary kind, and may be regarded as a terrier among stags. His colour is brown, his body is squat, and his legs are short. And what convinces me, that the size and stature of stags in general depend on the quantity and quality of their food, is, that having reared one at my house, and fed him very plentifully for four years, he was much taller, thicker, and plumper, at that age, than the oldest stags in my woods, which are, however, of a very good size.

Yellow is the most common colour of the stag. But many of them are brown, and others red. White stags are more rare, and seem to be a race that has become domestic, but very anciently; for both Aristotle and Pliny mention white stags; and they appear then to have been equally uncommon as at present. The colour of the horns, like that of the hair, depends on the age and nature of the animal, and the impression of the air. The horns of young stags are whitish, and less deeply coloured than those of the old. Stags, whose colour is a clear diluted yellow, have often pale ill-coloured horns. Those which are of a lively yellow have generally red horns; and brown stags, especially those which have black hair on the neck, have likewise black horns. The internal substance of the horns, it is true, is almost equally white in all stags; but they differ greatly in solidity and texture. Some of them are very spongy, and even contain pretty large cavities. This difference in texture is sufficient to account for their assuming different colours; and it is unnecessary to have recourse to the juices of trees, since we daily see the whitest ivory turn yellow or brown after being exposed to the air, though its texture be much more compact than that of the stag's horns.

The stag appears to have a fine eye, an acute smell, and an excellent ear. When listening, he raises his head, erects his ears, and hears from a great distance. When he is going into a coppice, or other half covered place, he stops to look round him on all sides, and scents the wind, to discover if any object is near that might disturb him. He is a simple, and yet a curious and crafty animal. When hissed or called to from a distance, he stops short, and looks stedfastly, and with a kind of admiration, at carriages, cattle, or men; and if they have neither arms nor dogs, he moves on unconcernedly, and without flying. He appears to listen, with great tranquillity and delight, to the shepherd's pipe; and the hunters sometimes employ this artifice to encourage and deceive him. In general, he is less afraid of men than of dogs, and is never suspicious, or uses any arts of concealment, but in proportion to the disturbances he has received. He eats slow, and has a choice in his aliment; and after his stomach is full, he lies down, and ruminates at leisure. He seems to ruminate with less facility than the ox. It is only by violent shakes that the stag can make the food rise from his first stomach. This difficulty proceeds from the length and direction of the passage through which the aliment has to go. The neck of the ox is short and straight; but that of the stag is long and arched; and therefore greater efforts are necessary to raise the food. These efforts are made by a kind of hiccup, the movement of which is apparent, and continues during the time of rumination. His voice is stronger, and more quivering, in proportion as he advances in years. The voice of the hind is shorter and more feeble. She never bellows from love, but from fear. The stag, during the rutting season, bellows in a frightful manner: he is then so transported, that nothing disturbs or terrifies him. He is therefore easily surprised; as he is loaded with fat, he cannot keep long before the dogs. But he is dangerous when at bay, and attacks the dogs with a species of fury. He drinks none in winter, nor in spring, the dews and tender herbage being then sufficient to extinguish his thirst. But during the parching heats of summer, to obtain drink, he frequents the brooks, the marshes, and the fountains; and in the season of love, he is so over-heated, that he searches every where for water, not only to satisfy his immoderate thirst, but to bathe and refresh his body. He then swims more easily than at any other time, on account of his fatness. He has been observed crossing very large rivers. It has even been alledged, that attracted by the odour of the hinds, the stags, in the rutting season, throw themselves into the sea, and pass from one island to another at the distance of several leagues. They leap still more nimbly than they swim; for when pursued, they easily clear a hedge or a pale fence of six feet high. Their food varies in different seasons. In autumn, after rutting, they search for the buds of green shrubs, the flowers of broom

or heath, the leaves of brambles, &c. During the snows of winter, they feed upon the bark, moss, &c. of trees; and in mild weather they browse in the wheat-fields. In the beginning of spring, they go in quest of the catkins of the trembling poplar, willow, and hazel trees, the flowers and buds of the cornel-tree, &c. In summer, when they have great choice, they prefer rye to all other grain, and the black berry-bearing alder to all other wood. The flesh of the fawn is very good; that of the hind and knobber not absolutely bad; but that of the stag has always a strong and disagreeable taste. The skin and the horns are the most useful parts of this animal. The skin makes a pliable and very durable leather. The horns are used by cutlers, sword-slippers, &c. and a volatile spirit, much employed in medicine, is extracted from them by the chymists.

SUPPLEMENT.

It is well known, that in many animals, as cats, owls, &c. the pupil of the eye contracts prodigiously in the light, and dilates in the dark. But this great contraction and dilatation had never been observed in the eyes of the stag. I received from M. Beccaria, a learned physician and celebrated professor at Pisa, the following letter, dated at Turin, October 28, 1767.

'I presented a piece of bread,' says M. Beccaria, 'to 'a stag that was confined in an obscure apartment, to 'allure him to a window, that I might admire at leisure 'the rectangular and transverse form of his pupils, 'which, in a strong light, exceed not half a line in width, 'by about five lines in length. In a fainter light, their 'breadth enlarges to more than a line and a half; but 'still preserve their rectangular figure: and in passing 'from light to darkness, they dilate about four lines, 'but always transversely, that is, horizontally, and pre-'serve their rectangular form. These facts may be easily 'ascertained, by laying the hand upon the eye of a stag; 'for whenever the eye is uncovered, the pupil will be 'seen dilated above four lines.'

From this fact M. Beccaria concludes with probability, that the other species of deer enjoy the same power of contracting and dilating their pupils. But what is most remarkable, the pupils of cats, owls, and several other animals contract and dilate vertically, while that of the stag contracts and dilates horizontally.

To the history of the stag, I must add a fact communicated to me by M. le Marquis d'Amezaga, who, to much learning, has joined great experience in the chase.

'Stags,' he remarks, 'shed their horns sooner or later 'in the month of March, in proportion to their ages. 'At the end of June, the horns of the old stag are long, 'and begin to tickle him. It is at this time also, that 'the stags begin to rub off the skin which covers their 'horns. At the commencement of August, their horns 'begin to assume that consistence which they retain 'during the rest of the year: on the 17th of October, the 'attendants of the Prince of Condé pursued a stag of six 'years old. This was the rutting season, when the stags 'are much less vigorous; but we were surprised to find 'the animal fly at a great rate, and lead near six leagues 'from his harbour.

'When this stag was seized, we found that his horns 'were white, and sprinkled with blood, as they ought 'to be at the time they are rubbed against the trees; 'and that they had still rags of the skin which covers 'them during the time of their growth. His horns were 'diversified with many branches. All the hunters who 'were in at the death expressed their surprise at these 'appearances. But their astonishment was augmented 'when they wanted to remove his testicles; for none 'were to be found in the scrotum. But after opening 'the body, two testicles were discovered in the abdomen 'about the size of filberds, and we clearly perceived 'that he had never experienced the effects of the rut. It 'is well known, that during the months of June, July, 'and August, the stags are prodigiously loaded with fat, 'which is generally so entirely exhausted about the 'middle of September, that nothing but the muscular 'flesh remains. But this stag had lost none of his fat, 'because he was never in a condition for rutting. He 'had still another singularity; for in the right foot he 'wanted the middle bone, which, in the left, was 'half an inch long, and as large and pointed as a tooth-'pick.

'It is well known that a stag, castrated when he has 'no horns, never afterwards acquires them, and that if 'the operation is performed when his horns are in per-'fection, they remain in the same state during life. 'Hence it appears, that the very minute organs of gene-'ration above described were sufficient to produce the 'annual change of horns; but that Nature has always 'proceeded slowly in the conformation of this animal; 'for we could discover no marks of any accident which 'could induce us to believe that the order of Nature had 'been deranged. It is, therefore, reasonable to suppose, 'that this retardation proceeded from the imbecility of 'the organs of generation, which, however, were suffi-'cient to produce the fall and renewal of the horns, 'since the cabbage or burs demonstrated, that at the 'time this stag was killed, he had had horns annually 'from the second to the sixth years.'

These observations of the Marquis d'Amezaga seem to prove, in a still stronger manner than any thing formerly remarked, that the fall and renovation of the stag's horns depend entirely on the presence of the testicles, and partly on their being more or less perfect; for in the instance before us, the testicles being imperfect and too small, the horns, for that reason, in their growth, shedding, and renewal, were much later than in other stags.

Pontoppidan, when speaking of the Norwegian stags, remarks, 'that they are only found in the dioceses of 'Bergen and Drontheim; that they sometimes swim in 'flocks across the straits between the continent and the 'neighbouring islands, resting their heads upon each 'other's crupper; and that when the chief of the file is 'fatigued, he retires behind to repose himself, and the 'most vigorous occupies his place.'

It has been thought, that the stags of our forests might, by treating them with care and gentleness, as the Laplanders manage the rein-deer, be rendered do mestic. Upon this subject, M. le Vicomte de Querhoent has communicated to me the following fact. Stags were first brought to the Isle of France by the Portuguese. They are small, and of a grayer colour than those of Europe, from whom, however, they derived their origin. When the French took possession of this island they found great numbers of these stags, of which they destroyed a part, and the remainder took refuge in the most retired places. They are now rendered domestic, and some of the inhabitants keep large flocks of them.

I have seen, at l'Ecole Veterinaire, a small kind of stag, which was said to have been brought from the Cape of Good Hope. Its skin was interspersed with white spots, like that of the axis. It was called the *Hog-stag*, because its legs were thicker, and it had not the same agility of body as the common kind. Its length from the muzzle to the extremity of the body, was only three feet four inches and a half; the legs were short, and the feet and hoofs very small; the colour yellow, mixed with white spots; the eye black and open, with large black hair on the upper eye-lid; the nostrils black, with a blackish band at the corners of the mouth; the colour of the head the same with that of the belly, only mixed with gray, and brown on the chanfrin and sides of the eyes; the ears very large, garnished on the inside with white hairs, and with smooth hair mixed with yellow on the outside. The horns of this stag were eleven inches seven lines in length, and ten lines thick. The top of the back was browner than the rest of the body. The tail was yellow above and white below; and the legs were of a brownish black colour.

This animal seems to approach nearer to the stag than the fallow-deer, as appears from the inspection of his horns.

THE FALLOW DEER.

THE horns of the fallow deer are palmated at their ends, and branched on the hinder side. It has two slender brow antlers, and above them two slender branches. The colour of this deer is various, being reddish, deep brown, white, or spotted.

No species of animals makes so near an approach to another as the fallow deer to that of the stag. But though their similarity be great in every respect, they fly from each other, never intermix, and of course, give rise to no intermediate race. It is even rare to find fallow deer in a country much frequented by stags, unless they are industriously transported thither. Their nature seems to be less rustic and robust than that of the stag; and they are likewise less common in the forests. They are kept in parks, where they may be said to be half domestic. More of them are reared in England than in any other country of Europe; and the English are extremely fond of their venison. The dogs also prefer the flesh of this deer to that of all other animals; and after they have once eat of it, they are extremely apt, in the chase of the stag or roe deer, to change their course when they perceive the scent of the fallow deer. In some provinces of France, and in the neighbourhood of Paris, there are fallow deer, as also in Spain and Germany. Those of America were probably transported from Europe. It seems to be an animal peculiar to the temperate climates; for there are none in Russia, and they are seldom met with in Sweden or other northern countries.

The stags are more generally diffused over Europe: they are even found in Norway, and all the northern regions, Lapland perhaps excepted. They are also frequent in Asia, especially in Tartary, and the northern provinces of China. They are likewise found in America; for those of Canada differ from ours in the length of their horns only, and the direction of their antlers, which is sometimes not straight, as in the common stag, but turned backward, so that the end of each points to the stem of the horns. But this form of the horns is not absolutely peculiar to the stag of Canada; or we find similar horns engraven in *la Venerie de Du Fouilloux*; and those of the Corsican stag have straight antlers; which is a sufficient proof that the Canadian stag is only a variety, to which stags of all countries are subject. There are likewise horns which have a number of antlers on their summits, in form of a crown. These are rarely found in France; but, says Du Fouilloux, they come from Russia and Germany. This is another variety only, and not a species different from the common kind. Hence in Canada, as well as in France, most stags have straight antlers; but in the former, they are larger and thicker; because they find in these uninhabited regions

more nourishment and repose than in populous countries. There are large and small stags in America, as well as in Europe. But however generally this species is diffused, it seems to be limited to cold and temperate climates. The stags of Mexico and South America, those of Cayenne, those called *Gange stags*, mentioned in M. Perrault's Memoirs, under the name of *Sardinian hinds*, those denominated *Cape stags*, and those of Guinea and other warm countries, belong not to the common species, as will appear when the particular history of each is given.

As the fallow deer is less savage, more delicate, and approaches nearer to the domestic state than the stag, he is also subject to a greater number of varieties. Beside the common and the white fallow deer, there are several other varieties, as those of Spain, which are nearly as large as the stag; but their neck is not so thick, and their colour is darker, with a blackish tail, not white below, and longer than that of the common kind; those of Virginia, which are almost as large as those of Spain, and remarkable for the great size of their genital organs: others have a compressed forehead, with the ears and tail longer than those of the common fallow deer, are marked with a white spot upon the hoofs of the hind feet; others are spotted with white, black, and yellow; and others are entirely black. All these have their horns flatter, broader, and better garnished with antlers than those of the stag; they likewise incline more inwardly, and are more palmated at the points; and when the horns are very strong, the largest antlers are sometimes terminated by small palms. The tail of the common fallow deer is longer than that of the stag, and its hair is brighter. The horns of the fallow deer shed, like those of the stag; but they fall off later, and are renewed nearly at the same time. Their rutting season arrives fifteen days or three weeks after that of the stag. The males then bellow frequently, but with a low and interrupted voice. They are not so furious as the stag, nor exhaust themselves by rutting. They never depart from their own country in quest of females; but they dispute and fight for the possession of their mistresses. They associate in herds, which almost always keep together. When there is a great number in one park, they generally form themselves into two distinct troops, which soon become hostile, because they both wish to occupy the same part of the inclosure. Each of these troops has its own chief, who marches foremost; and he is always the oldest and strongest of the flock. The others follow him; and the whole draw up in order of battle, to force the other troop from the best pasture. The order with which these combats are conducted is very singular. They make regular attacks, fight with courage, mutually support each other, and never think themselves vanquished by a single check; for the battle is daily renewed, till the weaker are completely defeated, and obliged to remain in the worst pasture. They love elevated and hilly countries. When chased, they run not out, like the stag, but double, and endeavour to conceal themselves from the dogs by artifice, and by substituting another animal in their place. However, when fatigued and heated, they take the water, but never attempt to cross such extensive rivers as the stag. Thus, between the chase of the fallow deer and stag, there is no material difference. Their knowledge and instincts, their shifts and doublings are the same, only they are more frequently practised by the fallow deer. As he is less enterprising, and runs not so far before the dogs, he has oftener occasion to change, or substitute another in his place, to double, return upon his former tracts, &c. which renders the hunting of the fallow deer more subject to inconveniencies than that of the stag. Besides, as he is smaller and lighter, the impressions of his feet upon the ground are slighter, and the branches he knocks off from the trees with his horns are smaller. Hence the dogs are less apt to observe the change or substitution of another animal, and it is more difficult to bring them into the scent when at fault.

The fallow deer is very easily tamed, and eats many substances which are rejected by the stag. He likewise preserves his fat or venison much better; for he is not rendered meagre by rutting, though followed by the longest and severest winters; and he is nearly in the same condition during the whole year. He browses closer than the stag, which makes the trees or bushes cut by him more difficult to shoot than those cut by the stag. The young fallow deer eat quicker, and with more avidity than the old. They ruminate; they search for the females in the second year, and attach not themselves to one, like the roe buck, but love variety, like the stag. The female goes with young eight months and some days. Like the hind, she produces one, sometimes two, and very rarely three fawns. They are capable of engendering and producing from the age of two to that of fifteen or sixteen years. Lastly, the fallow deer resemble the stag in almost all their natural dispositions and habits; the greatest difference between these two animals consists in the duration of their lives. We formerly remarked, from the testimony of huntsmen, that the stag lives thirty-five or forty years; and from the same authority, we learn that the fallow deer live only about twenty years. As they are smaller, it is probable that their growth is sooner accomplished than that of the stag; because, in all animals, the duration of life is proportioned to the time of growing, and not to the time of gestation; for here the time of gestation is the same. Besides, in other species, as that of the ox, though the time of gestation be long, the duration of life is short. Of course, we ought not to measure the duration of life by the time of gestation, but by that of the growth, reckoning from birth, nearly to the full expansion of the body.

THE ROE DEER.

THE roe deer has strong, upright, rugged, and trifurcated horns, from six to eight inches long. The length, from nose to tail, is three feet nine inches; the height before, is two feet three inches; behind, two feet seven inches; the length of the tail is only one inch. The weight of a full grown buck is near 60 lbs. The hair in summer is very short and smooth. The ends of the hairs are of a deep red colour, and the bottoms of a dark gray. In winter, the hairs are very long, and hoary at the tips, except at the back, where they are often very dark. The legs are slender; and beolw the first joint of the hind legs there is a tuft of long hair. The rump and under side of the tail are white.

As the stag is the noblest inhabitant of the wood, he occupies the deepest shades of the forest, and the most elevated ridges of those mountains which are covered with lofty trees. The roe deer, as if inferior in species, contents himself with a humbler residence, and generally dwells among the thick foliage of young brushwood. But if he is inferior to the stag in dignity, strength, and stature, he is endowed with more gracefulness, vivacity, and courage. He is superior in gaiety, neatness, and sprightliness. His figure is more elegant and handsome. His eyes are more brilliant and animated. His limbs are more nimble, his movements quicker, and he bounds, seemingly without effort, with equal vigour and agility. His coat, or hair, is always clean, smooth, and glossy. He never wallows in the mire like the stag. He delights in dry and elevated situations, where the air is purest. He is likewise more crafty, conceals himself with greater address, is more difficult to trace, and derives superior resources from instinct: for though he has the misfortune to leave behind him a stronger scent than the stag, which redoubles the ardour and appetite of the dogs, he knows how to withdraw himself from their pursuit, by the rapidity with which he begins his flight, and by his numerous doublings. He delays not his arts of defence till his strength fails him; but as soon as he finds that the first efforts of a rapid chase have been unsuccessful, he repeatedly returns to his former steps; and after confounding by these opposite movements, the direction he has taken, after intermixing the present with the past emanations from his body, he rises from the earth by a great bound, and retiring to a side, he lies down flat on his belly, and in this immoveable situation, he allows the whole troop of his deceived enemies to pass very near him.

The roe deer differs from the stag and fallow deer in disposition, temperament, manners, and almost every natural habit. Instead of associating in herds, they live in separate families. The father, mother, and young, go together, and never mix with strangers. They are constant in their amours, and never unfaithful like the stag. As the females generally produce two fawns, the one male and the other female, these young animals brought up and nourished together, acquire a mutual affection so strong, that they never quit each other, unless one of them meets with a misfortune, which never ought to separate lovers. This attachment is more than love; for though always together, they feel the ardour of the rut but once a year, and it continues only fifteen days, commencing at the end of October, and ending before the fifteenth day of November. They are not then, like the stag, overloaded with fat: they have no strong smell, no fury, in a word, nothing that can change the state of their bodies. During this period, they indeed suffer not their fawns to remain with them. The father drives them off, as if he meant to oblige them to yield their place to those which are to succeed, and to form new families for themselves. However, after the rutting season is past, the fawns return to their mother, and remain with her some time; after which they separate for ever, and remove to a distance from the place which gave them birth.

The female goes with young five months and a half, and brings forth about the end of April or beginning of May. The hinds, as formerly remarked, go with young above eight months; and this difference alone is sufficient to prove, that these animals are so remote from each other in species, as to prevent their ever intermixing or producing an intermediate race. By this difference, as well as those of figure and size, they approach the goat as much as they recede from the stag; for the goat goes with young nearly the same time, and the roe deer may be regarded as a wild goat, which, feeding solely on wood, carries *wood* instead of horns. The female, when about to bring forth, separates from the male. To avoid the wolf, who is her most dangerous enemy, she conceals herself in the deepest recesses of the forest. In ten or twelve days, the fawns acquire strength sufficient to enable them to follow her. When threatened with danger, she hides them in a close thicket, and to preserve them, presents herself to be chased. But notwithstanding all her care and anxiety

the young are sometimes carried off by men, dogs, or wolves. This is indeed the time of their greatest destruction. Of this species, which is not very numerous, I know, from experience, that more are destroyed in the month of May than during all the rest of the year. I often live in a part of the country where roe deer are greatly esteemed. Many fawns are annually brought me alive by men, and others killed by dogs, without reckoning those which are destroyed by wolves; and I have observed, during the space of more than twenty-five years, that, as if there were a perfect equilibrium between the causes of destruction and renovation, their number is always nearly equal in the same districts. It is not difficult to count them; for they are nowhere numerous, and they live separately in distinct families: in a coppice, for example, of 100 acres, there will be one family, or from three to five individuals; for a female, which generally produces two fawns, sometimes brings forth but one, and sometimes, though very seldom, three. In another district, of double the extent, there will be seven or eight, that is, two families: and I have remarked, that each district always harbours an equal number, except when the winters have been extremely rigorous and long: in this case the whole family are destroyed; but it is replaced by another the following year; and those districts, for which they have a predilection, are always inhabited nearly by an equal number. It is alledged, however, that in general their number is diminishing. There are whole provinces, it must be acknowledged, of France, where not one of them is to be found. Though common in Scotland, there are none in England. They are very rare in Italy; and they are now more scarce in Sweden than formerly, &c. But this effect may have proceeded from the diminution of forests, or from some very severe winter, like that of the year 1709, which almost destroyed the whole roe deer of Burgundy; so that several years passed before the species was recruited. Besides, they are not equally fond of every country; for in the same countries they prefer particular places. They love hills, or plains on the tops of mountains. They never stay in the deepest recesses of the forests, nor in the middle of extensive woods; but give the preference to the skirts or projections of woods which are surrounded with cultivated fields, and to open coppices which produce the berry-bearing alder, brambles, &c.

The fawns continue with their parents eight or nine months, and when separated, about the end of the first year of their age, their horns begin to appear in the form of two knobs much less than those of the stag. There is still a greater difference between these two animals: the horns of the stag shed in the spring, and are renewed in summer; but those of the roe deer fall off at the end of autumn, and are replaced in winter. Several causes concur in producing these different effects. In summer, the stag takes a great deal of nourishment, and grows exceedingly fat; he next exhausts himself so much in the rutting season, that the whole winter is necessary to recover his vigour. But during this season, instead of superabundant nourishment, he is half starved for want of subsistence, and consequently his horns cannot begin to shoot till the spring, when his nourishment begins to be redundant. The roe deer, on the contrary, who is never so much wasted, has no occasion for equal reparation; and, as he is never loaded with fat, as no change is produced in him by rutting, but continues always nearly the same, he has at all times a redundance of nourishment; so that, even in winter, and a short time after rutting, he sheds and renews his horns. Thus, in all these animals, the redundant organic nourishment, before it is determined to the seminal reservoirs, and forms the seminal fluid, is transferred to the head, and manifests itself externally by the production of horns; in the same manner as in man, the hair and the beard announce and precede the secretion of the seminal fluid: and it is apparent, that these vegetable productions, as they may be denominated, are formed of a redundant organic substance, but still imperfect, and mixed with brute particles, since they preserve, in their growth and substance, the qualities of vegetables. But the seminal fluid, the production of which is not so early, is a matter purely organic, deprived entirely of its brute particles, and perfectly assimilated to the body of the animal.

When the roe deer has renewed his horns, he rubs them against the trees, like the stag, in order to tear off the skin with which they are covered; and this commonly happens in the month of March, before the trees begin to shoot. Hence it is not the sap of the wood which colours the horns of the roe deer. However, the horns are brown when the animal is brown, and yellow when he is red; and, consequently, the colour of the horns proceeds, as formerly remarked, solely from the nature of the animal, and the impression of the air. The second horns of the roe have two or three antlers in each side; the third, three or four; the fourth, four or five, and they seldom have more. We distinguish the old ones by the thickness of the stems, the largeness of the bur, of the pearlings, &c. As long as the horns continue soft, they are extremely sensible: of this I have had a striking example; the young shoot of a roe buck's horn was cut off with a ball. The animal was stunned, and fell down as if he had been dead. The shooter, who was near, seized him by the foot; but the buck, suddenly recovering his senses and his strength, dragged the man, though he was strong and alert, thirty paces into the wood. After killing him with a knife, we discovered that he had received no other wound. Besides, it is well known that flies are very troublesome to the stag: when his horns are growing, he retires to

the deepest parts of the wood, where the flies are less numerous; because when they fix upon the tender horns, the irritation they occasion is insupportable. Thus there is an intimate communication between the soft parts of the horns, and the whole nervous system of the animal. The roe buck, who has nothing to apprehend from the flies, because he renews his horns in winter, never retires in this manner; but he walks with caution, and carries his head low, lest he should touch the branches.

In the stag, the fallow deer, and roe buck, the frontal bone has two processes or eminences, on which the horns rest. These processes begin to shoot at the age of five or six months, soon after acquire their full growth, and instead of rising higher in proportion as the animal advances in years, they annually sink and diminish; so that, in old stags or roe bucks, the burs are nearly supported upon the frontal bone, the processes of which having then become very broad and very short: this is the most certain mark by which the age of these animals can be distinguished. At first sight this fact appears to be singular, but admits of an easy explanation, when it is considered, that the horns, supported by these processes, press against them during the whole time of growth, which continues for several months every year: hence these bones, however hard, must become broader, and sink lower annually, by the great and long continued pressure they receive from every renewal of the animal's horns. It is for the same reason, that though the stems and burs, or rings, always grow thicker in proportion to the age of the animal, the height of the horns and the number of antlers diminish so fast, that when he is very old, they are only two thick knobs, with very small antlers.

As the female roe goes with young five months and a half only, and as the growth of the fawn is more rapid than that of the stag, the duration of her life is much shorter, seldom extending, I imagine, beyond twelve or fifteen years. I have reared several of them; but could never preserve them above five or six years. They are very delicate in the choice of their food, require a great deal of exercise, fine air, and much room, which is the reason why they are unable, except in the first years of their growth, to resist the inconveniences of a domestic life. To make a male live comfortably, he must be furnished with a female, and a park of a hundred acres. They may be tamed, but can never be rendered obedient or familiar. They always retain a portion of their natural wildness, are easily terrified, and then run with such force and precipitation against the walls that they often break their limbs. However tame they may be, they cannot be trusted; for the males particularly are subject to dangerous caprices; they take an aversion at certain persons, and make furious attacks with their horns, the blows of which are sufficient to knock a man to the ground, after which they continue to tread on him with their feet. The roe buck bellows not so frequently, nor with so loud or so strong a voice, as the stag. The young ones utter a short and plaintive cry, *mi...mi*, by which they indicate their want of food. This sound is easily imitated; and the mother, deceived by the call, will come up to the very muzzle of the hunter's gun.

In winter the roe bucks frequent the thickest coppices, and feed upon brambles, broom, heath, the catkins of the hazel, willow, &c. In spring they repair to the more open brushwood, and eat the buds and young leaves of almost every tree. This warm food ferments in their stomachs, and intoxicates them to such a degree that they are easily surprised. They know not where they are going, and not unfrequently come out of the wood, and sometimes approach flocks of cattle and the habitations of men. In summer they dwell in the more elevated coppices, from which they seldom depart, except in very dry weather, when they go to drink at some fountain; for when the dews abound, or the leaves are moistened with rain, they never drink. They are delicate in the choice of their food; they eat not with avidity, like the stag; and they seldom approach the cultivated fields, because they prefer the berry-bearing alder and bramble to grain or pot-herbs of any kind.

Though the flesh of these animals be excellent food; yet it admits of much choice. The quality of their venison depends chiefly on the country they inhabit; and even the best countries produce good and bad kinds. The flesh of the brown roe buck is finer than that of the red. All the males, after the age of two years, have hard and ill-tasted flesh; but that of the females, though farther advanced in years, is more tender. The flesh of the fawns, when very young, is loose and soft; but at the age of eighteen months it is in its highest state of perfection. Those which live in plains and valleys are not good; those that come from moist countries are still worse; those brought up in parks are insipid; and, lastly, there are no good roe bucks but those who inhabit dry and elevated countries, interspersed with hills, woods, cultivated and fallow lands, where they enjoy plenty of air, food, freedom, and solitude; for those which have been often disturbed are meagre, and the flesh of those that have been frequently hunted is dry and insipid.

This species, which is less numerous than that of the stag, and very rare in many parts of Europe, seems to be much more abundant in America, where there are two varieties, the red, which is the largest, and the brown, which has a white spot behind, and is smaller: and as they are found in the northern as well as the southern parts of America, it is probable that they differ more from each other than from those of Europe. They are very common, for example, in Louisiana, and

larger than those of France. They are likewise found in Brasil; for the animal called *Cujuaca-apara* differs not more from our roe buck than the stag of Canada from our stag. There is indeed a little variation in the figure of the horns, as appears from Perrault's figure of the Canadian stag, compared with the description and figure of the Brasilian stag given by Piso. 'In Brasil,' says Piso, 'there are roe bucks, of which some have no horns, 'and are called *Cujuaca-ete*, and others have horns, and 'are called *Cujuaca-apara*. The latter are smaller than 'the former; their hair is smooth, glossy, and mixed 'with brown and white, especially when the animals are 'young; for the white is effaced with age. The foot is 'divided into two black toes, upon each of which there is 'a smaller one superinduced; the tail is short; the eyes 'large and black; the nostrils open; the horns are of a 'middle size, and fall off annually. The female goes 'with young five or six months. They may be tamed,' &c. Margraave adds, 'that the horns of the *apara* have 'three branches, and that the inferior branch is longest 'and divided into two.' From these decriptions, it is apparent, that the *apara* is only a variety of our roe buck; and Ray suspects, that the *Cujuaca-apara* is the male, and the *Cujuaca-ete* the female, and that they both belong to the same species. I should willingly assent to Mr. Ray's opinion, if Piso had not expressly said, that those which have horns are smaller than the other kind. It is not probable that at Brasil the females of this species should be larger than the males, since every where else they are smaller. At the same time, though I believe the *Cujuaca-apara* to be only a variety of our roe buck, to which we may also add the *Capreolus marinus* of Johnston, I shall not decide concerning the *Cujuaca-ete* till farther information be obtained.

SUPPLEMENT.

It has frequently been mentioned, in my original work, that the common colours of wild animals are yellow, brown, and gray, and that the domestic state gives rise to white fallow deer, white rabbits, &c. I find, however, that Nature alone sometimes produces the same effect upon wild animals. M. l'Abbé de la Villette informs me, that a man belonging to his brother's estate, near Orgelet in Franche-comté, brought him two old roe deers, one of which was of the common colour, and the other, being a female, was as white as milk, and had no black but on the hoofs and the extremity of the nose.

Roe bucks, similar to those of Europe, are found throughout all North America; only they are larger, and their size increases in proportion as the climate becomes more temperate. The roe bucks of Louisiana are generally double the size of those of France. M. de Fontenelle adds, that they are easily tamed. In this he is supported by the evidence of M. Kalm, who mentions a roe buck which went daily to the wood in quest of food, and returned to his house in the evening. But in South America, this species is subject to great varieties. M. de la Borde, King's physician at Cayenne, says, 'that 'they have there four kinds of stags, called indiscriminately both males and females, by the name of *hinds*. 'The first kind, called *wood* or *red hinds*, keep perpetually in the thickest parts of the forest, to avoid being 'tormented by the flies. This kind is taller and thicker 'than that called the *savanna hind*, and yet it is exceeded 'in size by the *barallou hind*, which is the second species, 'and of the same colour with the wood hind. When 'the males are old, their horns consist of one branch 'only, and they at no period exceed four or five inches 'in height. These barallou hinds are rare, and combat 'the wood hinds. In these two species, at the side of 'each nostril, there are two considerable glands which 'secrete a white, fœtid humour.

'The third species is called the *savanna hind*. Its 'coat is grayish, and its limbs and body longer than the 'preceding. M. de la Borde was assured by the hunters, 'that the savanna hind had no glands on the nostrils, 'and that it was less savage, and even so curious as to 'approach men.

'The fourth species is the savanna hind, which is 'smaller and more common than the other three. They 'are not so wild, and their horns are longer and more 'palmated or branched than those of the other three 'kinds. They are called *savanna hinds*, because they 'frequent the watery savannas, and lands covered with 'marshes.

'These animals feed upon the manioc, and often destroy the plantations. Their flesh is very tender and 'well-tasted. Both the old and the young are used as 'food, and they are superior to the European stags. 'They tame so easily, that they run about the streets of 'Cayenne, and go out of the town and return, without 'being afraid of any object. The females even go into 'the woods in quest of wild males, and afterwards return 'with their fawns.

'The caricou is the smallest; his hair is of a whitish 'gray colour, and his horns are straight and pointed. 'He belongs rather to the roe buck than to the stag. 'He never appears near inhabited places; but is very 'common in large woods. However, he is easily 'tamed; and the female brings forth only one fawn 'every year.'

If the above descriptions be compared with what is afterwards remarked, in the history of the *Mazame*, or Mexican deer, it will appear, that all these pretended species of stags or hinds are only roe bucks, the varieties of which are more numerous in the New than in the Old Continent.

THE HARE.

THE hare has two cutting teeth in each jaw; long ears; a short tail; five toes before, and four behind. The ears are tipt with black; the eyes are large and prominent; the chin and whiskers white; the hair on the face, back, and sides, white at the bottom, black in the middle, and tipt with tawny red. The throat and breast are red, the belly white, and the tail black above, and white beneath. The feet are covered with hair, even at the bottom. A large hair weighs eight pounds and a half; its length, from the nose to the tail, is two feet.

The most numerous species of animals are by no means the most useful. Nothing can be more noxious than those multitudes of rats, mice, locusts, caterpillars, and other insects, the fecundity of which Nature seems rather to permit than to ordain. But the species of the hare and the rabbit afford to man the double advantage arising from number and utility. The hare is universally diffused over all the climates of the earth. The rabbits, though originally natives of particular climates, multiply so prodigiously wherever they are transported, that instead of being rooted out, much art is necessary to diminish their number, which is sometimes incommodious.

When we reflect on the amazing fecundity of each species, the rapid and prodigious multiplication of particular animals which come forth in myriads to ravage the earth, we are astonished that they oppress not Nature by their numbers, and after desolating her productions, fall victims to the universal waste they have created.

We view with terror the approach of those thick clouds, those winged armies of famished insects, which seem to threaten the whole globe with destruction, and, lighting on the fruitful plains of Egypt, or of India, annihilate in an instant, the labours and the hopes of nations; and sparing neither grain, nor fruits, nor herbs, nor leaves, nor roots, rob the earth of its verdure, and convert the richest countries into deserts. We behold descending from the mountains of the north, innumerable multitudes of rats, which, like an animated deluge, overwhelm the plains, spread over the southern provinces, and after destroying in their passage every thing that lives or vegetates, finish their noxious course, by infecting the earth and the air with the putrid emanations of their dead carcasses. In the southern regions, we behold, issuing suddenly from the deserts, myriads of ants, which, like an inexhaustible torrent, press forward in continued columns, drive men and animals from their habitations, and never retire till they have produced an universal devastation: and when men, like the animals, were half savage, and subject to all the laws and excesses of Nature, have not similar inundations of the human species taken place? Have not Normans, Huns, Goths, whole nations, or rather colonies of fierce and brutal people, without habitation or name, suddenly issued from their caverns, and with no other power but what arises from number, overturned cities and empires, and after laying waste the earth, repeopled it with men equally new and barbarous as themselves?

These great events, these remarkable æras in the history of the human race, are, however, only slight vicissitudes in the ordinary course of animated Nature, which, in general, is always the same: its movements are performed on two steady pivots, unlimited fecundity, and those innumerable causes of destruction which reduce the product of this fecundity to a determined measure, and preserve at all periods nearly an equal number of individuals in each species. And as those enormous multitudes of animals, which sometimes suddenly appear, vanish without augmenting the common stock, that of the human species, in like manner, continues always the same. The variations of the latter are only slower; because, the life of man being longer than that of small animals, more time is necessary to bring about the alternate changes of augmentation and diminution. But even this time, though it makes a deep impression, because it has been accompanied with horror and desolation, is only an instant in the succession of ages: for in estimating the whole human species that ever existed, the number of men, like that of all other animals, ought at all periods to be nearly the same, since it depends upon the equilibrium of physical causes; and this equilibrium, to which every thing has been long reduced, cannot be infringed either by the efforts of men, or by any moral circumstances, which are only particular effects of those physical causes. Whatever care man may bestow on his own species, he will never render it more numerous in one place, but at the expence of an equal diminution in another. When any portion of the earth is overstocked with men, they disperse or destroy each other, and often establish such laws and customs as give too great a check to this excess of multiplication. In remarkably prolific climates, as in China, Egypt, and Guinea, the inhabitants banish, mutilate, sell, or drown

their offspring: in France, and other catholic countries, they are condemned to perpetual celibacy. Those who exist, usurp easily the rights of those who have no existence: regarding themselves as necessary beings, they annihilate those which are contingent, and for their own convenience suppress future generations. The same restrictions are laid upon man, without his perceiving it, as are imposed upon the other animals: we cherish or multiply, neglect or destroy our species, according to the advantages or inconveniences which result from them: and as all moral effects depend upon physical causes, which, ever since the earth acquired its consistence, are fixed and permanent, the number of the human species, as well as that of all other animals, must likewise be constant and unalterable. Besides, this fixed state, this constant number, imply not absolute quantities. All physical and moral causes, and the effects that result from them, are balanced, and comprehended within certain limits, which are more or less extended, but never to such a degree as to destroy the equilibrium. As the whole universe is in perpetual motion, as all the powers of matter mutually act upon and counterbalance each other, every effect is produced by a kind of oscillations, to the middle points of which we refer the ordinary course of nature, and the extremes are those effects which are farthest removed from that course. Hence we find, that both in animals and vegetables an excessive multiplication is commonly followed by sterility: plenty and scarcity alternately succeed each other, and often so quickly, that a tolerable judgment may be formed of the produce of one year by that of the preceding year. Apple, plumb, oak, beech, and most fruit and forest trees, produce abundantly but once every other season. When caterpillars, flies, field mice, and other animals multiply to excess in one year, their number is greatly diminished the following year. If insects, during these fertile seasons, multiplied the next in proportion to their numbers, the whole fruits of the earth, all our domestic animals, and even man himself, would fall victims to their rapacity. But the causes of destruction and sterility immediately succeed those which give rise to a redundant multiplication. Neither is this destruction occasioned by contagion: it is a necessary consequence of too great a mass of animated matter collected in one place. In every species there are particular causes of death, as shall afterwards be shown, which are sufficient to compensate the excess of preceding generations.

I must again remark, that this reasoning is not to be understood in an absolute or even in a strict sense, especially with regard to those species which are not left entirely to the guidance of nature. Man, and the other animals he has taken under his protection and care, are more abundant than they would be without that attention he bestows on them. But as this care has also its limits, the augmentation which results from it has long been confined by immutable boundaries. And though, in civilized countries, the human species, as well as domestic animals, are more numerous than in other climates, they never multiply to excess; because, whenever they become incommodious, their number is diminished by the same power that produced them.

In districts appropriated to the pleasures of the chase, four or five hundred hares are sometimes killed in the course of a single day's sport. The multiplication of these animals is very rapid. From the first year of their existence they are always in a condition for propagating. The females go with young only thirty or thirty-one days. They bring forth three or four at a litter, and immediately afterwards they receive the male. They likewise admit him during the time of gestation, and from a peculiar conformation of their organs they have frequent superfœtations: for the uterus is only a continuation of the vagina, and has neither neck nor orifice, as in other animals; but in each horn there is an orifice opening into the vagina, which dilates during the time of bringing forth. Thus the horns are two distinct uteri, which can act independent of each other; so that the females of this species are capable of conceiving and bringing forth, at different times, by each uterus; and, consequently, superfœtations must be as frequent among these animals as they are rare in those which have not a double organ.

It is apparent, therefore, that the female hares may be in season and impregnated at all times. Another singularity in their structure proves them to be equally lascivious as they are fertile. The glans of the clitoris is prominent, and nearly as large as that of the male penis; and as the vulva is hardly visible, and the male, when young, has neither scrotum nor testicles on the outside of the body, it is often difficult to distinguish the females from the males. This peculiarity of structure has given rise to the following notions: that hermaphrodite hares are very common; that the males sometimes bring forth young; and that some are alternately males and females, and perform the functions of either sex, because the females, being more ardent than the males, often mount upon them, and because the external resemblance is so great, that unless narrowly examined, the one may easily be mistaken for the other.

The young, when brought forth, have their eyes open. The mother suckles them about twenty days; after which they separate, and procure their own food. They never remove far from each other, nor from the place where they are littered. They live, however, in solitude, each making a form or seat at the distance of sixty or eighty paces. Thus when we meet with one young hare, we are almost certain of finding two or three others in the neighbourhood. They feed more in the night than in the day; they eat herbs, roots, leaves, fruit,

grain, and prefer those plants which have milky juices. During winter they gnaw the bark indiscriminately from all trees except that of the alder, and lime, which they never touch. When reared in houses they are fed with lettuce and pot-herbs: but the flesh of those fed hares has always a bad taste.

During the day they sleep or repose in their forms, and are active only in the night, when they move about, feed, and copulate. When the moon shines they are seen playing together, leaping, and chasing each other. The smallest motion, or the noise of a falling leaf, is sufficient to terrify and make them fly different ways.

Some authors maintain that hares chew the cud. But I cannot assent to this opinion; because they have one stomach only, and its conformation, as well as that of the other intestines, are totally different from those of ruminating animals. The cæcum of the latter is small, but that of the hare is very large; and when to the capacity of the stomach this large cæcum is added, it is easy to perceive that the hare, by taking a great quantity of aliment, may live upon herbs alone, like the horse and ass, which have also a large cæcum, and but one stomach, and, consequently, are incapable of ruminating.

Hares sleep much, but always with open eyes. They have neither eye-lids nor cilia, and their eyes seem to be bad. But as a remuneration, they have an acute sense of hearing, and enormous ears in proportion to the size of their bodies. These long ears they move with great facility, and employ them as a rudder to direct their course, which is so rapid, that they outstrip all other animals. As their fore legs are much shorter than the hind legs, they run more easily up than down hill; hence, when pursued, they always take to the highest grounds. Their running is a kind of gallop, a succession of quick leaps. Their motion is not accompanied with noise; because their feet are covered, both above and below, with hair. They are perhaps the only animals which have hair in the inside of the mouth.

The duration of their life, like that of other animals, is proportioned to the time of their growth, which is completed in one year, and they live about seven. The males are said to live longer than the females. They pass their days in solitude and silence; and their voice is never heard but when seized or wounded: it is a loud, sharp cry, having some resemblance to the human voice. They are not so savage as their manners and habits would indicate: they are gentle, and susceptible of a kind of education. Though easily tamed, and even rendered caressing, they never acquire that attachment which is necessary to make them domestic; for when taken young, and brought up in the house, they take the first opportunity of regaining their liberty, and of flying to the fields. As they have a fine ear, sit spontaneously on their hind legs, and use the fore legs as a kind of hands, they have been trained to beat a drum, to perform gestures in cadence, &c.

In general, the hare wants neither instinct sufficient for his own preservation, nor sagacity for escaping his enemies. He forms a seat or nest: in winter, he chooses situations exposed to the south, and in summer, to the north. With a view to deceive, he conceals himself between clods or hillocks of the same colour with that of his own hair. 'I have seen,' says Fouilloux, 'a hare 'so sagacious, that after hearing the hunter's horn, he 'started from his form, and though at the distance of a 'quarter of a league, went to swim in a pool, and lay 'down on the rushes in the middle of it, without being 'chased by the dogs. I have seen a hare, after running 'two hours before the dogs, push another from his seat, 'and take possession of it. I have seen others swim 'over two or three ponds, the narrowest of which was 'eighty paces broad. I have seen others, after a two 'hours chase, run into a sheep-fold, and lie down among 'the sheep. I have seen others, when hard pushed, run 'in among a flock of sheep, and would not leave them. 'I have seen others, after hearing the noise of the 'hounds, conceal themselves in the earth. I have 'seen others run up one side of a hedge and return 'by the other, when there was nothing else between 'them and the dogs. I have seen others, after run-'ning half an hour, mount an old wall, six feet high, 'and clap down in a hole covered with ivy. Lastly, 'I have seen others swim over a river of about eighty 'paces broad, more than twice, in a length of two hun-'dred paces.'

But these facts unquestionably exhibit the greatest efforts of their instinct; for their ordinary resources are not so fine nor so complicated: when pursued, they first run with rapidity, and then double, or return upon their former steps. They always run in the direction that the wind blows. The females run not so far from their place of starting as the males; but they double oftener. In general, hares hunted in the place that gave them birth never remove to a great distance from it, but return to their form; and if chased two days successively, they perform, in the second day, the same doublings they had observed the day before. When a hare runs straight out, and to a great distance from the place he started, it is a proof that he is a stranger. It often happens, that male hares, especially during the most remarkable period of rutting, which is in the months of January, February, and March, when they have few females near them, perform journeys of several leagues in quest of mates; but as soon as they are started by the dogs, they fly back to the place of their nativity, and never more return. The females wander not in this manner. Though longer than the males, they are weaker and less agile; but they are more timid; for they

never allow the dogs to come so near their seats as the males, and their doublings are more frequent. They are also more delicate, and more susceptible of impressions from the weather. They avoid water and dews. But there are males called *measled hares*, which love marshy and watery grounds. The flesh of these hares is bad tasted; and in general, the flesh of all hares which inhabit valleys is whitish and insipid; but those of elevated or hilly countries, where the wild thime and other savory herbs abound, are extremely good. It has even been remarked, that those which live in the low woody grounds of the same country, are not near so good as those that inhabit the ridges of hills, or the cultivated fields, and vineyards; and that the flesh of the female is always more delicate than that of the male.

The nature of the soil has a considerable influence on the hare, as well as upon all other animals. The mountain hares are larger than those of the plains, and likewise of a different colour. The former are browner, and have more white under the neck than the latter, which are almost red. In high mountains, and in northern regions, they become white during winter, and resume their usual colour in the summer. Only a few, and perhaps these are very old, continue white; for they all turn more or less white with age. The hares of Italy, Spain, and Barbary, are smaller than those of France and other northern nations. According to Aristotle, they are smaller in Egypt than in Greece.

Hares are equally diffused over all climates. They abound in Sweden, Denmark, Poland, Russia, France, Britain, Germany, Barbary, Egypt, the islands of the Archipelago, and particularly Delos, which was called *Lagaia* by the ancient Greeks, because of the number of hares which were found there. Lastly, hares are numerous in Lapland, where they are white for ten months of the year, and resume their proper colour during the two warm months of summer only. Hence it appears, that every climate is nearly equal to these animals. It has, however, been remarked, that they are less frequent in the East than in Europe, and that they are very rare in South America, though they again make their appearance in Virginia, Canada, in the neighbourhood of Hudson's Bay, and the Straits of Magellan. But these North American hares are perhaps a different species from ours; for travellers inform us, that they are not only much larger, but that their flesh is white, and of a different taste from that of the common kind. They add, that the hair of the North American hares never falls off, and that their skins are excellent furs. In excessively hot countries, as Senegal, Gambia, Guinea, and particularly in the cantons of Fida, Apam, Agra, and some other regions situated under the Torrid Zone, both in Africa and America, as in New Holland, and the Isthmus of Panama, there are animals which have been called hares by travellers, but are rather a species of rabbit; for the rabbit is a native of warm climates, and is never found very far to the north; but hares are larger and stronger in proportion to the coldness of the country they inhabit.

This animal, though so much in request for the tables of Europeans, is not relished by the Oriental nations. The flesh of the hare, it is true, as well as that of the hog, was interdicted by the law of Mahomet, and still more anciently by the Jewish law. But it was much esteemed by the Greeks and Romans. It must indeed be allowed, that not only the flesh, but the blood of this animal, is excellent. The fat contributes nothing to the delicacy of the flesh; for the hare, in his natural state of perfect liberty, is never fat; but when fed in the house, he often dies merely by the load of fat he acquires.

The hunting of the hare is the amusement, and not unfrequently the sole occupation of the idle: as it requires little apparatus or expence, and is even useful, it is a diversion universally agreeable. In the mornings and evenings, the hunter watches at the edges of the wood, the goings out or returning of the hares. During the day, he searches for them in their forms. When the air is clear and the sun brilliant, an expert hunter will discover, at a considerable distance, a hare that has been chased, by the fumes which arise from its body. Conducted by this mark, I have seen men, whose eyes were accustomed to this kind of observation, part from their company, and go to the distance of half a league to kill a hare in its seat. Hares allow a very near approach, if they are not advanced upon directly, but by a winding and seemingly inattentive motion. They are more afraid of dogs than of men, and start sooner when they hear or perceive a dog. Though the hares run faster than the dogs; yet as they never fly straight out, but double about the place where they were started, the greyhounds, who hunt more by the eye than the scent, generally overtake and kill them. In summer, they frequent the fields, the vineyards in autumn, and the woods or coppices in winter; and in all seasons, they may be raised and chased by hounds. They may also be taken by birds of prey. A perpetual war is carried on against them by owls, buzzards, eagles, foxes, wolves, and men. So numerous are their enemies, that they escape by chance only, and are rarely allowed to enjoy the small portion of time allotted them by Nature.

SUPPLEMENT.

It is universally known, that hares make forms, and burrow not in the ground, like rabbits. But I have been informed by an able naturalist, M. Hettlinger, superintendant of the Pyrennean mines, that in the mountains in the neighbourhood of Baigory, the hares often make holes in the clefts of rocks, which is not considered as remarkable.

It is likewise well known, that hares do not willingly inhabit places which are frequented by rabbits; but it also appears that rabbits do not multiply in countries where hares are numerous:

'In Norway,' says Pontoppidan, 'rabbits are found 'only in a few places; but hares are very frequent. 'Their hair, which is brown and gray during summer, 'becomes white in winter. *Like cats, they take and eat 'mice*, and are of a smaller size than those of Denmark.'

That hares eat mice, is extremely improbable: but it is not the only marvellous or false fact related by the good Bishop of Bergen.

'The hares of the Isle of France,' remarks M. le Vicomte de Querhoent, 'are not larger than French rabbits. 'Their flesh is white and they burrow not in the 'ground. They are very numerous; their hair is 'smoother than that of our hares; and they have a large 'black spot on the hind part of the head and neck.'

M. Adanson likewise asserts, that the hares of Senegal are not entirely similar to those of France; that they are somewhat less; that their colour is a mixture between that of the hare and the rabbit; and that their flesh is exquisitely delicate.

THE RABBIT.

THE ears of the common rabbit are almost naked. The colour of the fur, in a wild state, is brown; that of the tail is black above and white beneath. In a domestic state, the colour varies from black to pied and perfectly white; the eyes of the last are of a fine red.

As the hare and rabbit, though very similar both in external form and internal structure, never intermix, they constitute two distinct species. However, as it has been maintained by hunters, that male hares, in the rutting season, pursue and cover female rabbits, I endeavoured to discover what would result from this union. For this purpose, I reared together male rabbits and female hares, and female rabbits and male hares. But nothing was produced from these trials. I only learned from them, that these animals, though very similar in form, are so different in their natures, as to be incapable of producing mules. I put a young hare and a young female rabbit in the same apartment; but they lived not together three months. As soon as they acquired a little strength, they became mortal enemies, and their continual wars terminated in the death of the hare. Of two male hares farther advanced in life, which I confined separately with a female rabbit, one suffered the same fate; and the other, which was very strong, and very ardent, perpetually tormented the rabbit with attempts to cover her, and at last killed her by wounds, or by too violent caresses. I made similar trials with three or four male rabbits, and an equal number of female hares; but the latter died in a still shorter time. Though nothing was produced, I am inclined to think that they sometimes actually coupled. It is certain, at least, that notwithstanding the resistance of the female, the male was gratified.

The fecundity of the rabbit is still greater than that of the hare. Without believing, with Wotton, that from a single pair put upon an island, six millions were found at the end of one year, it is certain that these animals multiply so prodigiously in a country which is commodious for them, that the produce of the earth is not sufficient to afford them subsistence. They devour herbs, roots, grain, fruits, and even young trees and shrubs; and if not furnished with dogs and ferrets, the inhabitants would be obliged to desert these countries. The rabbit not only produces more frequently, and in greater number than the hare, but has likewise more resources for escaping his enemies. He easily abstracts himself from the observation of man. The holes which he digs in the earth, where he retires during the day, and impregnates his mate, protect him from the ravages of the wolf, the fox, and birds of prey. Here the whole family live in perfect security. The females nourish their young about two months, and never allow them to go out of their retreat till they are able to shift for themselves. By this means, they avoid all the dangers of youth; while more hares, on the contrary, are destroyed during this period than in all the after part of their lives.

This management is alone sufficient to prove that the rabbit is superior in sagacity to the hare. The structure of both is the same, and might enable them equally to dig retreats in the earth. Both are equally timid; but the talents of the one being weaker than those of the other, he contents himself with forming a seat on the surface of the ground, where he remains perpetually exposed; while the rabbit, endowed with a superior instinct, digs for himself an asylum in the earth. This labour is unquestionably the effect of sentiment; for domestic rabbits never give themselves the trouble of digging. They dispense with digging retreats, for the same reason that domestic birds dispense with building

nests, because they are equally sheltered from the inconveniences and dangers to which wild birds and wild rabbits are continually liable. It has often been remarked, that when a warren is attempted to be replenished with domestic rabbits, both they and their offspring remain, like the hares, upon the surface; and that they never begin to dig holes for their protection, till after they have endured many hardships, and passed through several generations.

The colours of the domestic rabbit vary, like those of all other domestic animals; for we have white, black, brown, and spotted rabbits. The black rabbits are rarer than the white, brown, or variegated kinds. All wild rabbits are brown; and even among the domestic ones, it is still the predominant colour; for in every litter, though both male and female be white, or both black, or the one white and the other black, some of the young are always brown. It is seldom that above two or three resemble the parents. But the brown rabbits, though in a domestic state, generally produce young of their own colour only; and it is very rare, and as by accident, that they bring forth white, black, or mixed kinds.

At the age of five or six months these animals are capable of procreating. They are said to be constant in their amours; and after attaching themselves to a particular female, generally never quit her. The female is almost perpetually in a condition for receiving the male. She goes with young thirty or thirty-one days, and produces from four to eight at a litter. Like the female hare, she has a double uterus, and consequently may bring forth at two different times. Superfœtations, however, seem to be less frequent in this species than in that of the hare. This circumstance may perhaps be owing to the constancy of the females, and to their indulging in fewer adventures and unseasonable embraces.

Some days before bringing forth they dig a new hole, not in a straight line, but angular; at the bottom of which they make an excavation; and they pull great quantities of hair off their bellies, and make a bed of it for the reception of their young. During the two first days, they never leave their offspring: they never go out but when pressed with hunger, and return as soon as they have filled their stomach, which they do with surprising quickness. In this manner they tend and suckle their young for more than six weeks, during which the father has no knowledge of them. He never enters the hole dug by the mother; and the female, when she leaves her young, frequently shuts up the mouth of the hole with earth diluted in her own urine. But when they begin to come to the mouth of the hole, and to eat groundsel, or other herbs, presented to them by the mother, the father seems to know them: he takes them between his paws, smooths their hair, and licks their eyes. Each of them, one after another, equally partakes of his care and attention. He receives, at the same time, many caresses from the mother; and in a few days afterwards she is generally impregnated.

I received the following remarks from M. le Chapt du Moutier, who has amused himself for several years in rearing rabbits: 'I began,' says he, 'with only one 'male and one female. The male was perfectly white, 'and the female brown. In their posterity, which was 'very numerous, the brown greatly predominated; there 'was a considerable number of them white and mixed, 'and some black. When the female is in season, the 'male seldom quits her. His constitution is so vigorous 'and ardent, that I have seen him embrace the female 'five or six times in less than an hour. In the time of 'coition, the female lies flat on her belly, with her four 'paws stretched out; and she utters small cries, which 'rather indicate pleasure than pain. Their manner of 'coupling resembles that of the cats, with this difference, that the male bites the neck of the female with 'less violence. These animals pay much respect to 'their fathers, which I discovered by the great deference 'my rabbits entertained for their original father, who 'was easily distinguished by his whiteness, being the 'only male of this colour which I preserved. The family 'soon increased: but those who had likewise become 'fathers were always subordinate to their first sire. Whenever they fought, either for females or food, the grandfather ran up to them with full speed; and as soon as 'they perceived him order was re-established. If he 'surprised them in the act, he first separated the combatants, and then gave them an exemplary punishment. I had a still farther proof of his dominion over 'his posterity. Having accustomed them to retire into 'their apartment upon the blowing of a whistle, when I 'gave the signal, however distant they might be, the 'grandfather put himself at their head, and though he 'arrived first, he allowed them all to pass before, and 'entered last himself. I fed them with bran, hay, and 'a good deal of juniper; of this last they eat the berries, the leaves, the bark, and leave nothing but the 'wood. This food gave a fine flavour to their flesh, and 'made it equally good as that of the wild rabbit.'

These animals live eight or nine years. As they pass the greatest part of their lives in holes, where they enjoy perfect tranquillity, they grow much fatter than hares. Their flesh differs likewise both in colour and taste. The flesh of the young rabbit is very delicate; but that of the old is dry and hard. As I formerly remarked, they are originally natives of warm climates. They were known to the Greeks; Greece and Spain seem to be the only places in Europe where they anciently existed. From thence they were transported into more temperate regions, as Italy, France, Germany, Britain, where they are now naturalized. But in very cold countries, as Sweden, and other parts of the north they cannot be

reared in houses, and they perish when abandoned to the fields. But, on the contrary, they are fond of excessive heat; for we find them in the most southern parts of Asia and Africa, as along the Persic Gulf, the bay of Saldana, in Lybia, Senegal, and Guinea. They are likewise found in our American islands, where they have been brought from Europe, and have succeeded extremely well.

OF CARNIVOROUS ANIMALS.

HITHERTO we have treated of useful animals only. The noxious species are few in number; and though, upon the whole, what is hurtful seems to abound more than what is serviceable, yet every thing is well ordered; for in the physical world evil is subservient to good, and there is nothing really noxious in nature. If the destruction of animals be hurtful, is not man, considered as forming a part of the general system of animation, the most noxious and pernicious of all beings? He alone sacrifices and annihilates more individuals than the whole carnivorous tribes. The latter are hurtful only because they are rivals to man, because they have the same appetites, the same taste for animal food, and because, in obedience to this unavoidable and necessary desire, they sometimes dispute with him that prey which he would engross for the gratification of his inordinate appetite; for man always sacrifices more to his intemperance than to his real wants. Born to destroy the subordinate races of animals, he would exhaust all nature, if by a fecundity superior to his depredations she did not repair the perpetual havock he makes. But death is only the minister of life, and destruction is the parent of reproduction. However great therefore the waste made by man and the carnivorous animals, the fund or total quantity of life is never diminished; for in proportion to their premature destruction, fresh births are produced.

Large animals constitute but a small part of life: the earth teems with the smaller tribes. Every plant, every grain, every particle of organized matter, contains millions of animated atoms. Vegetables seem to be the great fund of subsistence; but this fund, however inexhaustible, would hardly be sufficient to the still more numerous tribes of insects. Their fecundity, which is equally great, and often quicker than the reproduction of plants, indicates the superiority of their numbers: for plants are only renewed every year; but a single season gives birth to several generations of insects, especially among the minuter tribes. Their multiplication, therefore, if they were not devoured by other animals, would exceed that of vegetables. But many insects feed upon other insects: some tribes, as the spiders, devour indifferently their own as well as many other species; the whole are eaten by the birds; and the wild and domestic fowls serve as nourishment to man, or become the prey of carnivorous animals. Thus violent deaths are equally necessary as natural ones; they are both modes of destruction and of reproduction; the one continues nature in perpetual youth, and the other preserves the order of her productions, and limits the number of species. Both are effects depending upon general causes: every individual drops at the end of a determined period; or if prematurely cut off, it was because he was superfluous. How many flowers are cropped in the spring? What numberless beings are extinguished the moment they begin to exist? How many germs are annihilated before they are unfolded? Man and the carnivorous animals feed upon individuals either completely formed, or about to exist. Flesh, eggs, seeds, and germs of every species, constitute their ordinary nourishment. This waste alone might limit the exuberance of nature. Let us attend to one of those inferior species that serve for nourishment to others. The herrings, for example, present themselves in myriads to our fishers; and after feeding all the monsters of the northern ocean, they furnish subsistence to Europe during a certain part of the year. If incredible numbers of them were not devoured by other animals, what would be the effects of such an amazing multiplication? They alone would cover the whole surface of the sea. But by their numbers, they would soon injure and destroy each other. For want of sufficient nourishment their fecundity would diminish. Contagion and famine would produce the same effects as the present consumption; the number of these animals would by no means increase; but the number of those that feed upon them would greatly diminish. And as the same remark may be applied to any other species, they must of necessity prey upon one another. Hence the killing of animals is both a lawful and an innocent practice, because it is founded in nature, and they hold their existence under that seemingly hard condition.

It must be allowed, however, that the motives which have raised doubts concerning this matter, do honour to

humanity. Animals, at least those who are endowed with senses, and are composed of flesh and blood, are sensitive beings: like us, they are capable of pleasure, and subject to pain. To sacrifice unnecessarily those animals who approach or live with us, and who, like man, exhibit symptoms of pain when injured, indicates a cruel insensibility; for those whose nature differs greatly from ours, cannot affect us. Natural pity is founded on the analogy which takes place between us and the object that suffers, and the degree of it is proportioned to the nearness of this conformity or resemblance in structure. The word compassion implies a division of suffering. In man the sentiment of pity belongs more to the body than to the mind; and the animals are also susceptible of it. They are moved by the voice of pain; they run to succour each other; they recoil at the view of a dead body of their own species. Thus horror and pity are not so much passions of the mind, as natural affections depending on the sensibility of the body, and similarity of structure. This emotion, therefore, ought to diminish in proportion as different animals recede from each other in their nature and conformation. The beating of a dog, or the killing of a lamb, excite our compassion: but we feel no emotion when a tree is felled or an oyster swallowed.

Animals, whose organization resembles that of man, must have similar sensations; and the liveliness of these sensations must he proportioned to the activity and perfection of their senses. Those on the other hand, whose senses are blunt, cannot have exquisite feelings; and those who are deprived of any organ of sense, must likewise want the corresponding sensations. Motion is a necessary effect of the exercise of sentiment. We formerly proved, that whatever be the organization of an animal, if it be endowed with sentiment, it must exhibit its feelings by external movements: Thus plants, though properly organized, are insensible beings, as well as those animals who have no apparent motion. In the same manner, animals, who like the sensitive plant, move their bodies only, but are deprived of progressive motion, have very little sentiment; and even those who are endowed with the power of moving progressively, but whose actions, like those of automatons, are extremely limited in number, and always performed in the same manner, have only a small portion of sentiment, which is confined to a few objects. In the human species there are many automatons: education, and the mutual communication of ideas, by means of social intercourse, augment both the quantity and the vivacity of our sentiments. What a vast difference, in this respect, between a savage and a civilized man, between a female Hottentot and a woman of fashion? Among the animals, in like manner, those who live in a domestic state have their feelings improved by their frequent intercourse with man; while those who remain wild preserve only their natural sensibility, which is often more certain, but always more confined than that which is acquired by education and example.

Besides, considering sentiment entirely as a natural faculty, independent of the movements produced by it, we may still ascertain its different degrees by physical relations, to which too little attention has hitherto been given. To possess a high degree of sensibility, the animated body must form a whole, not only sensible in all its parts, but so constructed that these parts intimately correspond with each other in such a manner, that an impression made upon one, must necessarily be communicated to all the rest. There must also be a common centre, upon which the various impressions or vibrations must terminate, and this centre must, like a fulcrum, re-act and reflect all these movements. Thus man, and those animals who resemble him most in organization, will be the most sensible beings. Those on the contrary, who form not so complete a whole, whose parts have a less intimate correspondence, who have several centres of feeling, and who, under the same covering, seem not to include one perfect animal, but various centres of existence separate from each other, are beings of much less sensibility. When a polypus is cut in pieces, each division lives separately: the head of a wasp, after being divided from the body, lives, moves, and even eats as formerly; a lizard, though cut asunder, is neither deprived of motion nor of feeling; the limbs of a lobster are renewed after amputation; the heart of a turtle continues to beat long after it is cut out of the body; the principal viscera of insects, as the heart and lungs, make not a whole in the centre of these animals, but extend along the body, and form a succession of unconnected hearts and wind-pipes: all these, and similar animals, whose organization is so far removed from that of man, have little sentiment.

In man, and in the animals which resemble him, the diaphragm appears to be the centre of sentiment: it is upon this nervous part, which conveys the impressions of pain and of pleasure, that all the movements of the sensible system are exerted. The diaphragm makes a transverse division of the body into two equal parts, the superior of which includes the heart and lungs, and the inferior contains the stomach and intestines. This membrane is endowed with such an extreme sensibility, and is so necessary to the communication and propagation of feeling, that the slightest wound, whether in its centre or circumference, is always accompanied with convulsions, and often with death. The brain, therefore, which has been considered as the seat of sensation, is by no means the centre of sentiment; for it may be wounded, and even parts of it cut away, without destroying the animal.

Sensation, therefore, ought to be distinguished from sentiment. Sensation is only a vibration, or impression on the sense; but sentiment is the same sensation rendered agreeable or disagreeable by the propagation of the vibration through the system. The essential characteristic of sentiment is pleasure or pain; for all other movements, though they pass within us, are totally indifferent, and do not effect us. All the external motions, and the exercise of every animal force, depend on sentiment, which only acts in proportion as it is affected. The diaphragm, therefore, which we consider as the centre of sentiment, is also the centre of force, or common fulcrum upon which every force is exerted.

All lively emotions, whether pleasant or painful, sickness, fainting, and every sensation that has become agreeable or disagreeable, are felt internally in the region of the diaphragm. In the brain, on the contrary, there is no indication of sentiment. We feel only pure sensations in the head. We can, indeed, recal any sensation, whether agreeable or disagreeable; and if this operation, which is performed in the head, be followed by a real and lively sentiment, we immediately feel the impression of it in the region of the diaphragm. Thus in the fœtus, where this membrane is not exercised, there is no sentiment, or at least it is so feeble as to produce no effect; for the little motions of a fœtus are mechanical, and have no dependence either on sensation or on the will.

Whatever be the nature of that matter, which serves as a vehicle to sentiment, and gives rise to muscular motion, we know that it is propagated by the nerves, and that it is instantaneously communicated from one extremity of the system to the other. We know not how this movement is performed, whether by vibrations like those of elastic cords, or by a subtle fire similar to that of electricity, which resides not only in animated and inanimated bodies, but is perpetually regenerated by the motion of the heart and lungs, by the friction of the blood in the arteries, and also by the action of external causes upon the organs of sense. It is certain, however, that the nerves and membranes are the only sensible parts of an animal body. The blood, the lymph, the fat, the bones, the flesh, and all the other solids and fluids are, in themselves, totally insensible. The brain is a soft unelastic substance, and of course incapable of producing or of propagating the vibrations of sentiment. The meninges, on the contrary, which serve as an envelope or covering to all the nerves, are exceedingly sensible. Like the nerves, the meninges originate in the head, and like them, they divide into branches, and extend along with their most minute ramifications. They may be regarded as nerves rendered flat; for they are of the same substance, have nearly the same degree of elasticity, and form a necessary part of the sensible system. If the head, therefore, be the seat of sensation, it must reside in the meninges, and not in the medullary part of the brain, the substance of which is entirely different.

The opinion, that the brain is the fountain of sensation, and the centre of all sensibility, arose from this circumstance, that the whole nerves, which are the organs of sensation, terminate in the brain; and hence it was regarded as the only part to receive every impression or vibration. This supposition appeared so simple and so natural, that the physical impossibility which it implies, though abundantly evident, was never attended to: how can an insensible part, a soft inactive substance, such as the brain, be itself the instrument of all sensation and motion? How can this soft insensible substance not only receive impressions, but retain them for a long time, and propagate vibrations through all the solid and sensible parts of the body? It may, perhaps, be replied, with Descartes and Peyronie, that the principle of sensation resides not in the brain, but in the pineal gland, or in the cortical substance. But from examining the parts of the brain, it is apparent, that neither the pineal gland nor cortical substance contain nerves: they are surrounded with the insensible part of the brain, and so separated from the nerves, that they can receive none of their movements. Hence these suppositions, as well as the former, fall to the ground.

But what is the use, what are the functions of this noble and principal part of the body? Is not the brain found in every animal? Is it not larger in man, in the quadrupeds, and in the birds, who have all a great deal of sentiment, than in fishes, insects, and other animals which have little sentiment? When compressed, is not all motion suspended? If this part is not the principle of action, why is it so essentially necessary? Why is it even proportioned, in every species of animals, to the quantity of sentiment they possess?

These questions, however difficult they may appear, admit of easy solutions. Upon an attentive and unprejudiced examination, the brain, as well as the medulla oblongata, and spinal marrow, which is a prolongation of the brain, are only a species of mucilage, and hardly organized. We discover in it, indeed, the extremities of small arteries, which terminate there in vast numbers, and carry no blood, but a white nutritious lymph only. These minute arteries, or lymphatic vessels, when separated from the brain by maceration, appear like very fine threads. The nerves, on the contrary, never penetrate the substance of the brain, but terminate on its surface; but they first lose their solidity and elasticity; and their extremities next the brain are soft, and almost mucilaginous. Hence the brain, which is nourished by the lymphatic arteries, furnishes, in its turn, nutriment to the nerves, which ought to be considered as a species of vegetation issuing from the brain in trunks and branches, which afterwards divide into an infinite number of

ramifications. The brain is to the nerves what the soil is to the plants: the extremities of the nerves are the roots which, in every vegetable, are more tender and soft than the trunk or branches. They contain a ductile matter proper for the growth and nourishment of the nervous tree. This ductile matter they derive from the substance of the brain itself, to which the arteries perpetually carry the necessary supplies of lymph. The brain, therefore, instead of being the origin of sensation, or the principle of sentiment, is only an organ of secretion and nutrition, but a very essential organ; for without it, the nerves would neither grow nor be supported.

The brain is largest in man, quadrupeds, and birds; because the quantity of nerves is greater than in the fishes and insects, whose sentiment, for this reason, is feeble: the latter have a small brain, proportioned to the small quantity of nerves it has to nourish. On this occasion, I must remark, that man's brain, as has been alledged, is not proportionally larger than that of any other animal: there are a species of monkeys and of the cetaceous tribes which have larger brains, in proportion to the size of their bodies, than man: and this fact likewise proves, that the brain is neither the seat of sensation, nor the principle of sentiment; for if this were the case, these animals would have finer sensations and more sentiment than the human species.

Plants absorb not the solid parts of the earth or water: these parts must be reduced by heat into thin vapours, before they can be absorbed by the roots. In the same manner the nerves are nourished by the subtile moisture of the brain, which is absorbed by their extremities or roots, and from thence conveyed to all the branches of the sensitive system. This system, as formerly remarked, forms a whole, all the parts of which have such an intimate connection, that none of them can be injured without wounding the rest. The slightest irritation of a small nerve is sufficient to convulse the whole body; and the pain and consequent convulsions cannot be cured but by cutting the nerve above the injured part; and then all the parts upon which this nerve was distributed, become for ever immoveable and insensible. The brain ought not to be regarded as an organic portion of the nervous system; because it has not the same properties, nor consists of the same substance, being neither solid, nor elastic, nor sensible. I acknowledge, that when compressed, sensation ceases. But this alone proves it to be a body foreign to the nervous system, which, acting by its gravity on the extremities of the nerves, presses and benumbs them, in the same manner as a weight applied to the arm, leg, or any other part of the body, benumbs the nerves, and annihilates their sensation. It is true, this cessation of feeling, by compression, is only a suspension or a benumbing, which vanishes the moment the compression is removed, and sensation and motion are again renewed. I farther acknowledge, that by tearing the medullary substance of the brain, convulsions, privation of feeling, and death itself, will ensue. But these effects are produced, because the nerves are entirely deranged, and the whole of them materially injured in their very source.

To these arguments particular facts might be added, which would equally show that the brain is neither the centre of sentiment, nor the seat of sensation. We have seen animals, and even children, born without head or brain, and yet they had sentiment, motion, and life. There are whole classes of animals, as insects and worms, in whom the brain is not perceptible, having only a part corresponding to the medulla oblongata and spinal marrow. It is therefore more rational to place the seat of sensation in the spinal marrow, which no animal wants, than in the brain, which is not an universal part, common to all sensitive beings.

The great obstacle to the advancement of human knowledge lies not in the objects themselves, but in our manner of considering them. Man's body, however complicated, is more simple than his ideas. It is less difficult to see nature as she is, than to know her in the dress she is exhibited to us. She only wears a veil; but we give her a mask. We conceal her with prejudices. We suppose that she operates as we act and think. Her actions, however, are evident; but our thoughts are obscure. To her operations we transfer the abstractions of our own minds. We judge of her designs by our own views; and we perpetually blend her works which are uniform, her facts which are always certain, with the fluctuating illusions of our own imagination.

I speak not here of systems purely arbitrary, or of frivolous and imaginary hypotheses, but of the methods generally employed in the investigation of nature. Even the method of experiment has produced more errors than truths. This method, though the most certain, requires great dexterity of management: a small deviation either leads to barren regions, or to rare and obscure objects. We nevertheless assemble them together, and ascribe to them general relations and common properties: and as mankind pass and repass on the crooked paths which have been formed, the road appears to be clear and beaten. Though it terminates in nothing, the whole world follows, the method is adopted, and the consequences derived from it are received as fixed principles. I might demonstrate this doctrine by exposing the origin of what are called principles in all the sciences, both abstract and real: in the former, the general basis of the principle is abstraction, or one or two suppositions: in the latter, the principles are only consequences, good or bad, of the methods which have been observed. I shall here limit myself to the science of anatomy: Did not the first man who, contrary to a repugnance of nature, opened a human body, believe that, by dissecting and examining its different parts, he would soon discover

ts structure, mechanism, and functions? But having found the subject to be infinitely more complicated than he imagined, he was soon obliged to renounce his pretensions, and to institute a method not for distinguishing and judging, but solely in order that he might see the parts in a certain train or order. Many ages were necessary to bring this method to any degree of perfection; and it alone still occupies the attention of our most accomplished anatomists. This method, however, is not the science, but only the road which ought to lead to it, and which perhaps might have led to it, if instead of travelling always in the same narrow path, anatomists had extended the track, and compared the human body with that of other animals. What real knowledge can be derived from a single object? Is not every science founded on the comparison of similar and different objects, of their analogous or opposite properties, and of all their relative qualities? Absolute knowledge, if it has an existence, exceeds the powers of man: we can judge only by the relations of things. When solely occupied with the method of investigating a subject, and when we consider it independent of what is analogous, or different from it, we can never arrive at real knowledge, and far less rise to any general principle: in this case we can invent names only, and make descriptions of the object, and of all its parts. Thus though human bodies have been dissected for three thousand years, anatomy is still nothing but a nomenclature; and hardly any advances have been made toward the real object, which is the knowledge of the animal œconomy. Besides, the method itself is still imperfect, though it ought to be clear and simple, since it depends on inspection, and has no end but that of denominations? As this nominal knowledge has been mistaken for science, anatomists, instead of limiting the number of objects, have been anxious to augment the number of names. They have loaded the subject with minute and fruitless details. They were inclined to discover differences where every thing was alike. In creating new names, they imagined they were exhibiting new objects; and the description of a minute part, which had been either overlooked or neglected by former anamotists, was dignified with the appellation of a *discovery*. Even the names themselves, being frequently substituted in the place of the objects, with which they have no relation, have only served to augment the confusion. Are not the *nates* and *testes* small parts of the brain similar to the whole, and unworthy to be distinguished by particular denominations? These names, bestowed originally from caprice, at last gave rise to new opinions and prejudices. Others, given to parts which either did not exist, or were imperfectly viewed, have been the sources of fresh errors. How many functions and uses have been ascribed to the pineal gland, and that pretended void in the brain, called the *fornix*, while the former is only a simple gland, and the existence of the latter is doubtful, being probably produced by the hand of the dissector.

The most difficult part of science, therefore, is not to know those things which form the direct object of it, but to strip them of a thousand false colours under which they have been concealed, to examine the foundation and effects of the method employed by former inquirers, to reject every arbitrary arrangement, and in fine, to endeavour to reject every error or prejudice that has been adopted. All these precautions are necessary to uncover nature; but to know her, we have only to compare her with herself. In the animal œconomy her appearance is very mysterious, not only because the subject is complex, but because having neglected those modes of comparison which alone could afford light, we have been left to wander in the darkness of vague hypotheses. The human body has been described in millions of volumes; while the anatomy of the other animals has been almost entirely neglected. In the human subject we have distinguished, named, and described the most minute parts; while we are ignorant whether these, or even parts of greater magnitude and importance, exist in other animals. Particular functions have been ascribed to particular organs, without knowing whether the same functions are not performed in other beings, though deprived of these organs. So that, in the different explications of the animal œconomy, we labour under the double disadvantage of having commenced with the most complicated subject, and of reasoning concerning this subject without the aid of analogy.

In the course of this work we have observed a very different method. Uniformly comparing nature with herself, we have traced her in her relations, in her differences, and in her extremes. To mention here only those parts relative to the animal œconomy, of which we have had occasion to treat, as the generation, the senses, the movements, the sentiment, and the nature of animals, the reader will easily perceive, that after all the labour bestowed in discarding false ideas, in rooting out established prejudices, and in separating truth from arbitrary conceits, the only art we have employed is that of comparison. If we have succeeded in throwing light upon these subjects, it must be ascribed not so much to ingenuity or labour as to the method we have followed, and which we have endeavoured to render as general as our knowledge would permit. Before giving general ideas, we have invariably exhibited the particular results or effects.

We shall now content ourselves with relating a few facts, which will be sufficient to prove that man, in the state of nature, was never destined to live upon herbs, grain, or fruits; but that in every period of his existence, he, as well as most other animals, eagerly desired to nourish himself with flesh.

The Pythagorean diet, though extolled by ancient and

modern philosophers, and even recommended by certain physicians, was never indicated by Nature. In the golden age, man was innocent as the dove; his food was acorns, and his beverage pure water from the fountain: finding every where abundant subsistence, he felt no anxieties, but lived independent, and always in peace both with himself and the other animals. But he no sooner forgot his native dignity, and sacrificed his liberty to the bonds of society, than war and the iron age succeeded that of gold and of peace. Cruelty, and an insatiable appetite for flesh and blood, were the first fruits of a depraved nature, the corruption of which was completed by the invention of manners and of arts.

These are the reproaches which in all periods have been thrown upon man, in a state of society, by certain austere and savage philosophers: flattering their private pride, by the humiliation of the whole species, they have exhibited this unnatural picture, which has no value but in the contrast: to hold out to man chimerical ideas of happiness, may perhaps be sometimes useful.

Did this state of ideal innocence, of exalted temperance, of entire abstinence from flesh, of perfect tranquillity, of profound peace, ever exist? Is it not a fable, where man has been employed as an animal, to give us lessons of moral instruction? Is it even possible to conceive the existence of virtue previous to society? Does the loss of this savage state merit regret? Was man, while a wild, unsocial animal, more dignified than the polished citizen? Yes; for every evil springs from society; and what does it import whether there was virtue in a state of nature, if it gave rise to happiness, if man were only less miserable than in his present condition? Liberty, health, strength, are not these perferable to effeminacy, sensuality, and voluptuousness, accompanied with slavery? The absence of pain is more estimable than a thousand pleasures: what is happiness, but to have nothing to desire?

If this representation were just, they should go farther, and tell us, that it is better to vegetate than to live, to have no desires than to gratify our appetites, to doze perpetually in apathetic slumbers, than to open our eyes to view the beauties of Nature, and, in a word, to sink below the condition of brutes, or to become masses of inanimate matter attached to the earth, than to be active and sentient beings, capable of receiving pleasure from a thousand sources.

But instead of disputing, let us attend to facts: we see not the ideal, but the real state of nature. Is the savage inhabitant of the desert a tranquil being? Is he a happy man? For we must not suppose, with a certain philosopher, one of the most ferocious censors of humanity, that the distance from man, in a pure state of nature, to the savage, is greater than from the savage to us; that the ages elapsed before the invention of words, have been longer than those which were necessary for the perfecting of signs and of language. I have always thought, that in reasoning concerning facts, all suppositions ought to be banished, till every thing presented by Nature be candidly examined. Now we find that mankind descend, by imperceptible degrees, from the most enlightened and polished nations, to people of less genius and industry; from the latter, to others more gross, but still subject to Kings and to laws; from these, again, to savages, who exhibit as many different shades as the polished nations. Some savages form numerous nations subject to chiefs; smaller societies of them are governed by customs; and the most solitary and independent species constitute families, and submit to their fathers. Thus an empire and a monarch, a family and a father, are the two extremes of society. These extremes are likewise the boundaries of Nature: if they extended farther, in traversing the numberless solitudes of the globe, we must have discovered those human animals, who, like the monkeys, are deprived of speech, the males separated from the females, their offspring abandoned to the elements, &c. Even supposing the constitution of the human body to be very different from what we see it, and that its growth were more rapid, it is impossible to maintain that man ever existed without forming families; because, if not cherished and attended for several years, the whole children must have inevitably perished. Whereas, other animals require the care of the mother a few months only. This physical necessity is a perfect demonstration, that the human species could neither multiply nor exist independent of society; and that the attachment of parents to children is natural. This attachment must unite the parents and children into a small society, which alone would be sufficient to accustom them to make certain gestures, to utter certain sounds, and inure them to every expression of sentiment and of desire. All this is attested by facts; for the most solitary savages have, like other men, the use of signs and of words.

Thus the state of pure nature is a known state: it is that of the savage living in the desert, but living in family, knowing his children, and being known by them, using words, and making himself understood. The savage girl picked up in the woods of Champagne, and the man found in the forests of Hanover, are not exceptions to this doctrine. They had lived in absolute solitude; and could not, therefore, have any idea of society, or of the use of words: but if they had ever met, the propensity of Nature would have constrained, and pleasure united them. Attached to each other, they would soon have made themselves understood; they would have first learned the language of love, and then that of tenderness for their offspring. Besides, these savages must have sprung from men in society, and been left in the woods at the age of four or five years; for before this period, they could not have existed. They must

have been old enough to be able to procure subsistence, but not to retain the ideas which had been communicated to them.

Let us then examine this man of Nature, this savage living in the family state. If the family prospers, he will soon become the chief of a numerous society, of which all the members will have the same manners, observe the same customs, and speak the same language. At the third or fourth generation, new families will arise, who may live separately; but being united by the common bonds of customs and language, they will form a small nation, which, increasing with time, may, according to circumstances, either become one people, or remain in a state similar to that of those savage nations with which we are acquainted. If these new men live under a mild climate, and upon a fertile soil, they may occupy, in the full possession of liberty, a considerable space, beyond which, if they meet with nothing but deserts, or men equally new with themselves, they will remain savage, and become, according to circumstances, either friends or enemies to their neighbours. But when under a severe climate, or ungrateful soil, they find themselves pinched by numbers, or cramped for want of room, they will make irruptions, form colonies, and blend themselves with other nations, of which they will either become the conquerors or the slaves. Thus man in every situation, and under every climate, tends equally toward society. It is the uniform effect of a necessary cause; for without this natural tendency, the propagation of the species, and of course, the existence of mankind, would soon cease.

Having discussed the origin of society, and shown that it is founded on Nature, let us next inquire what are the appetites and taste of savages. In this investigation we shall find that none of them live solely on fruits, herbs, or grain; that they all prefer flesh and fish to other aliments; that pure water is not pleasant to them; and that they endeavour either to make for themselves, or to procure from others, a less insipid beverage. The savages of the South drink the water of the date tree; those of the North swallow large draughts of whale oil; others make fermented liquors; and the whole, without exception, discover a violent passion for ardent spirits. Their industry, dictated by necessity, and excited by their natural appetites, is confined to the making of instruments for hunting and fishing. A bow and arrows, a club, a net, and a canoe, constitute the whole of their arts, and are all destined to procure a species of food corresponding to their taste: and what corresponds with their taste, must be agreeable to Nature; for, as formerly remarked, man would die of inanition, if he took not more substantial food than herbs alone. Having but one stomach and short intestines, he could not take a sufficient quantity of such meagre food as would afford him proper nourishment. The same remark is applicable to fruits and grain; for though corns and other grains have been highly improved by culture, and contain a greater quantity of organic nutritive particles, than any of those which are produced spontaneously by Nature; yet if men were denied any other food, he would only drag out a feeble and languishing existence.

View those solitary enthusiasts, who abstain from every thing that has had life,-who, from motives of sanctity, renounce the gifts of the Creator, fly from society, and shut themselves up within sacred walls, against which Nature continually revolts: confined in those living tombs, where they contemplate nothing but death, their mortified visages and hollow eyes indicate perpetual efforts to support a languishing, feeble, and useless existence. They take food; but their hunger never abates. Though aided by the fervour of a romantic imagination, they are enabled to resist the effects of this cruel abstinence for a few years only, and may be said rather to die daily than to live.

If man were obliged to abstain totally from flesh, he could not, at least in our climates, either exist or multiply. This diet may, perhaps, be sufferable in southern countries, where the fruits are better concocted, and the plants, roots, and grains more nourishing. The Brahmans, however, rather form a sect than a people; and their religion, though very ancient, has never extended beyond their own climate.

This religion, founded on metaphysics, is a striking example of the lot of human opinions. By collecting the scattered fragments which remain, it is unquestionable that the sciences have been very anciently cultivated, and perhaps ripened to a degree of perfection beyond what they now are. It has been known, long before the present æra, that all animated beings contained indestructible living particles, which passed from one body to another. This truth, adopted at first by philosophers, and afterwards more generally diffused, would preserve its purity during the enlightened ages only. A revolution of dark periods having succeeded, no more of the living organic particles were remembered than what was sufficient to give rise to the notion, that the living principle of animals constituted an indestructible whole, which separated from the body after death. To this ideal whole they gave the name of Soul, which they soon regarded as a being really existing in all animals; and combining with this chimerical being, the real, but disfigured idea of the passage of living particles, they maintained, that after death, this soul transmigrated successively and perpetually from one body to another. From this system man was not excepted: they quickly associated morality with metaphysics: they hesitated not to hold that this surviving being retained, in all its transmigrations, its former sentiments, affections, and desires. Weak minds trembled. They contemplated

with horror the passage of the soul from an agreeable lodging to be an inhabitant of an unclean and loathsome animal. Every new fear engenders a fresh superstition. In killing an animal they were terrified lest they should murder their mistress or their father. They regarded every brute as their neighbour; and at last, both from motives of tenderness and of duty, they maintained that they ought to abstain from every thing endowed with life. This is the origin and progress of the most ancient religion of India: an origin which shows that truth, when committed to the multitude, is soon disfigured; that a philosophical opinion never becomes popular till it has changed its form; but that, by means of this preparation, it may prove the basis of a religion, the stability of which will be proportioned to the universality of the prejudice, and being founded on truths misunderstood, it must be environed with obscurity, and of course it will have an air of mystery, of grandeur, and of incomprehensibility: in fine, that fear, combining with reverence, will make this religion degenerate into superstitious and ridiculous practices, which, however, will take root, and produce rites that at first will be scrupulously observed, but will so gradually alter with time, that even the opinion which gave them birth can only be traced in false traditions, in proverbs, and in tales puerile and absurd. From hence we may conclude, that every religion founded on human opinions is false and variable; and that to promulgate the true religion, which depends not on the fancies of men, and which is constant, unalterable, and will always be the same, is the prerogative of God alone.

But to return to our subject. An entire abstinence from flesh can have no effect but to enfeeble nature. Man, to preserve himself in proper plight, requires not only the use of this solid nourishment, but even to vary it. To obtain complete vigour he must choose that species of food which is most agreeable to his constitution; and as he cannot preserve himself in a state of activity but by procuring new sensations, he must give his senses their full stretch, and eat a variety of meats, to prevent the disgust arising from an uniformity of nourishment. But he must avoid every excess, which is still more noxious than abstinence.

Those animals which have but one stomach and short intestines are obliged, like man, to feed upon flesh. It is an unquestionable fact, that all animals which have more stomachs than one, and long intestines, like the cow, sheep, goat, &c. are herbivorous, and that those which have but one stomach, and short intestines, like men, dogs, wolves, lions, &c. are carnivorous.

It must not, however, be concluded, that herbivorous animals are under a physical necessity of feeding on herbs alone, though the carnivorous tribes can by no means subsist without flesh. We maintain only, that the former can be sufficiently nourished without the use of flesh; not that they would not have recourse to this food if nature had endowed them with talent adapted to the purposes of seizing prey; for we have seen sheep, calves, goats, and horses, eat with avidity milk, eggs, and even flesh, when cut down and seasoned with salt, though they had not been previously accustomed to such food. We may therefore maintain, that the taste for flesh is an appetite common to all animals, and that it is exerted with more or less vehemence or moderation according to their particular conformation; for this appetite is apparent not only in man and the quadrupeds, but in birds, fishes, insects, and worms; to the last of which, it would appear, all flesh has been ultimately destined by nature.

Nutrition, in every animal, is performed by organic particles, which, after being separated from the gross mass of aliment, by means of digestion, mingle with the blood, and are assimilated to all the parts of the body: but independent of this principal effect, which is always proportioned to the quality of food, another effect is produced, which depends on the quantity or bulk of the nourishing substances. The stomach and intestines consist of flexible membranes, which occupy a considerable space within the body. These membranes, to preserve them in a proper state of tension, and to counterbalance the action of the neighbouring organs, require to be always partly filled. If for want of nourishment this large space be left entirely void, the membranes, having no internal support, collapse, and adhere to each other, which gives rise to weakness, and all the symptoms of extreme want. Thus the aliments, beside answering the purposes of nutrition, serve as a ballast to the body. Both their presence and their volume are necessary to maintain the equilibrium between the internal parts, which act and re-act against each other. When a man dies of hunger, it is not so much for want of nourishment, as of a proper poise to the body. Thus animals, and especially the most voracious tribes, when pressed with hunger, are so eager to fill the internal void, that they swallow earth and stones. Clay has been found in the stomach of a wolf; and I have seen swine eat it greedily. Most birds swallow pebbles, &c. This is not the effect of taste but of necessity; for the most craving want is, not to refresh the blood with new chyle, but to maintain an equilibrium in the action of the great parts of the animal machine.

THE WOLF.

THE wolf is ranked in the same genus with the dog by Linnæus, and by Mr. Pennant; the latter of whom describes him in the following manner: 'WOLF---Dog 'with a long head, pointed nose, ears erect and sharp, 'tail long, bushy, and bending down; teeth large; co-'lour generally pale brown, tinged with yellow; some-'times found white, and sometimes black; taller than a 'large greyhound.'

The wolf is one of those animals whose carnivorous appetite is excessively strong. Though he has received from nature the means of gratifying his taste, though she has bestowed on him arms, craftiness, strength, agility, and every thing necessary for discovering, seizing, conquering, and devouring his prey; yet he often dies of hunger; because men have declared war against him, put a price on his head, and forced him to fly to the forests, where he finds only a few species of wild animals, who escape from him by the swiftness of their course, and whom he cannot surprise but by chance, or by a patient and often fruitless attendance at those places to which they generally resort. He is naturally clownish and dastardly; but want makes him ingenious, and necessity gives him courage. When pressed with famine, he braves danger; he attacks those animals which are under the protection of man, especially such as he can transport with ease, as lambs, small dogs, and kids; and when successful in his bloody expedition, he returns often to the charge, till being wounded, chased, and maltreated by men and dogs, he retires, during the day, to his den; but issues forth in the night, traverses the country, roams about the cottages, kills all the animals which have been left without, digs the earth under the doors, enters with a dreadful ferocity, and puts every living creature to death, before he chooses to depart and carry off his prey. When these inroads happen to be fruitless, he returns to the woods, searches about with avidity, follows the track of wild beasts, and pursues them in the hope that they may be stopped and seized by some other wolf, and that he may be a partaker of the spoil. In fine, when his hunger is extreme, he loses the idea of fear; he attacks women and children, and even sometimes darts upon men, till becoming perfectly furious by excessive exertions, he generally falls a sacrifice to pure rage and distraction.

The wolf, both externally and internally, has so strong a resemblance to the dog, that he seems to have been formed upon the same model. But he exhibits the same characters under a mask. The figure is similar, but the result is directly reversed. Their natural dispositions are so opposite, that they are not only incompatible, but repugnant by nature, and inimical by instinct. A young dog trembles at the first glance of a wolf. The odour of the wolf, though new and unknown, excites such an aversion in the dog, that he flies, and comes quivering to the feet of his master. A mastiff, who knows his own strength, though terrified at the appearance of a wolf, attacks him with courage, endeavours to put him to flight, and exerts every effort to get rid of an odious object. They never meet but either flight or death is the consequence. When the wolf is strongest, he mangles and devours his prey. The dog, with more generosity, contents himself with victory; he finds no savoury odour in the body of a dead enemy, but abandons him to be food for the ravens, and even to other wolves; for wolves eat the carcasses of each other, and when one is much wounded, the others follow the blood, and assemble in troops to dispatch him.

The dog, even when wild, is not a fierce animal. He is easily tamed, and attaches himself with fidelity to his master. The young wolf may also be tamed; but he feels no attachments; nature in him, is too powerful for education: with age he resumes his ferocious character, and returns, with the first opportunity, to his savage state. Dogs, even those of the most clownish race, love to associate with other animals, and are naturally disposed to accompany them: it is by instinct alone, and not by education, that they know how to conduct and guard the flocks. The wolf, on the contrary, is an enemy to all society, and keeps no company even with those of his own species. When several wolves appear together, it is not a society of peace but of war; it is attended with tumult and dreadful prowlings, and indicates an attack upon some large animal, as a stag, an ox, or a formidable mastiff. This military expedition is no sooner finished than they separate, and each returns in silence to his solitude. There is even little intercourse between the males and females: they feel the mutual attractions of love but once a-year, and never remain long together. The females come in season in winter: many males follow the same female; and this association is more bloody than the former; for they growl, chafe, fight, and tear one another, and often sacrifice him that is preferred by the female. The female commonly flies a long time, fatigues her

admirers, and retires, while they sleep, with the most alert or most favourite male.

The season of love continues only twelve or fifteen days; it commences with the oldest females; the young ones are not so early disposed. The males have no marked period, but are equally ready at all times. They go from female to female, according as they are in a condition to receive the male: they begin with the old females about the end of December, and finish with the young ones in the month of February or beginning of March. The time of gestation is about three months and a half; and young whelps are found from the end of April to the month of July. This difference in the time of gestation between the she-wolf, who carries 100 days, and the bitch who carries only 60 days, proves that the wolf and dog differ as much in their constitutions, and particularly in one of the chief functions of the animal œconomy, as they do in their tempers. Thus the wolf and dog have never been regarded as the same animal but by the nomenclators of natural history, who being acquainted with the surface of Nature only, never extend their views beyond their own methods, which are always deceitful, and often erroneous, even in the most obvious facts. The dog and wolf cannot copulate, or produce an intermediate race. Their dispositions are opposite, and their constitutions different. The wolf lives much longer than the dog; the former brings forth but once a-year, and the latter twice or thrice. These distinctions are more than sufficient to demonstrate the two animals to be of very different kinds. Besides, upon a closer examination, we easily perceive, that even externally, the wolf differs from the dog by essential and uniform characters. The appearance of the head and form of the bones are by no means the same. The cavity of the eye in the wolf is placed obliquely; the orbits are inclined; the eyes sparkle, and shine in the dark; instead of barking, he howls; his movements, though quick and precipitate, are more equal and uniform; his body is stronger, but not so flexible; his members are firmer, his jaws and teeth larger, and his hair coarser and thicker.

But these animals have a great resemblance in their internal structure. The wolves copulate like the dogs, and have an osseous penis, surrounded with a ring, which swells and hinders them from separating. When the females are about to bring forth, they search for a concealed place in the inmost recesses of the forest. After fixing on the spot, they make it smooth and plain for a considerable space, by cutting and tearing up with their teeth all the brambles and brush-wood. They then bring great quantities of moss, and prepare a commodious bed for their young, which are generally five or six, though sometimes they bring forth seven, eight, and even nine, but never less than three. They come into the world blind, like the dogs; the mother suckles them some weeks, and soon learns them to eat flesh, which she prepares for them by tearing it into small pieces. Some time after, she brings them field-mice, young hares, partridges, and living fowls. The young wolves begin by playing with these animals, and at last worry them; then the mother pulls off the feathers, tears them in pieces, and gives a part to each of her young. They never leave their den till the end of six weeks or two months. They then follow their mother, who leads them to drink in the hollow trunk of a tree, or in some neighbouring pool. She conducts them back to the den, or when any danger is apprehended, obliges them to conceal themselves elsewhere. Though, like other females, the she-wolf is naturally more timid than the male; yet when her young are attacked, she defends them with intrepidity; she loses all sense of danger, and becomes perfectly furious. She never leaves them till their education is finished, till they are so strong as to need no assistance or protection, and have acquired talents fit for rapine, which generally happens ten or twelve months after their first teeth, which commonly fall out in the sixth month, are replaced.

Both males and females are capable of generating at the age of two years. The females, it is probable, like those of other species, are sooner mature for this operation than the males. It is certain, however, that they never come in season before the second winter after birth, which implies 18 or 20 months. A she-wolf which I brought up, discovered no marks of love till the third winter, or more than two years and a half. We are assured by hunters, that in every litter there are more males than females; which confirms the general remark, that in every species, the number of males exceeds that of the females. They likewise tell us, that some males attach themselves to the females, after the season of love is over, and accompany them till they are about to bring forth; that then the female steals off, and anxiously conceals her young, lest the father should devour them immediately after birth; but that when brought forth he takes an affection for them, supplies them with food, and if deprived of their mother, provides for and protects them himself. These facts, however, have the air of fiction, and seem contrary to the natural dispositions of the wolf.

Wolves acquire their full growth at the end of two or three years, and live 15 or 20 years. This fact accords with what we have already remarked concerning many other species, that the time of growth is the seventh part of the total duration of life. When old, wolves turn whitish, and their teeth are much worn. When full, or fatigued, they sleep, but more during the day than the night, and it is always a kind of slight slumber. They drink often; and in the time of drought, when

there is no water in the hollows, or in the trunks of old trees, they repair several times in a day, to the brooks or rivulets. Though extremely voracious, if supplied with water, they can pass four or five days without meat.

The wolf has great strength, especially in the anterior parts of the body, in the muscles of the neck and jaws. He carries a sheep in his mouth, and at the same time, outruns the shepherds; so that he can only be stopped or deprived of his prey by dogs. His bite is cruel, and always more obstinate in proportion to the smallness of the resistance; for when an animal can defend itself, he is cautious and circumspect. He never fights, but from necessity, and not from motives of courage. When wounded with a ball, he cries; and yet when dispatching him with bludgeons, he complains not. He is harder, less sensible, and more robust than the dog. He runs and roams about whole days and nights; and of all animals he is perhaps the most difficult to conquer in the chase. The dog is gentle and courageous; the wolf, though ferocious, is timid. When he falls into a snare, he is so overcome with terror, that he may be either killed or taken alive, without resistance. He allows himself to be chained, muzzled, and led where you please, without exhibiting the least symptom of resentment or discontent. The senses of the wolf are excellent, but particularly his sense of smelling, which often extends farther than his eye. The odour of carrion strikes him at the distance of more than a league. He likewise scents live animals very far, and hunts them a long time by following their track. When he issues from the wood, he never loses the wind. He stops upon the borders of the forest, smells on all sides, and receives the emanations of living or dead animals brought to him from a distance by the wind. Though he prefers living to dead animals; yet he devours the most putrid carcasses. He is fond of human flesh, and were he stronger, he would perhaps eat no other. Wolves have been known to follow armies, to come in troops to the field of battle, where bodies are carelessly interred, to tear them up, and to devour them with an insatiable avidity: and when once accustomed to human flesh, these wolves ever after attack men, prefer the shepherd to the flock, devour women, and carry off children. Wolves of this vicious disposition are distinguished by the name of *Loups garoux*, or wolves that should be guarded against.

Whole countries are sometimes obliged to arm, in order to destroy the wolves. Princes have particular equipages for this species of hunting, which is both useful and necessary. Hunters distinguish wolves into young, old, and very old. They are known by the tracks of their feet. The older the wolf, his feet are the larger. The she-wolf's feet are longer and more slender; her heel is also smaller, and her toes thinner. A good blood-hound is necessary for hunting the wolf; and when he falls into the scent, he must be coaxed and encouraged; for all dogs have an aversion to the wolf, and proceed with coldness in the chase. When the wolf is raised, the greyhounds are let loose in pairs, and one is kept for dislodging him, if he gets under cover; the other dogs are kept as a reserve. The first pair are let after the wolf, and are supported by a man on horseback; then the second pair are let loose at the distance of seven or eight hundred paces; and lastly, the third pair, when the other dogs begin to join and tease the wolf. The whole together soon reduce him to the last extremity; and the hunters complete the business by stabbing him with a dagger. The dogs have such a reluctance to the wolf's flesh, that it must be prepared and seasoned, before they will eat it. The wolf may also be hunted with beagles or hounds; but as he darts always straight forward, and runs for a whole day without stopping, the chase is irksome, unless the beagles be supported by greyhounds, to tease him, and give the hounds time to come up.

In the country, though men, attended with mastiffs, beat the bushes, lay snares and baits, dig pits, and scatter poisoned pieces of meat; yet the number of these destructive animals never decreases, especially in woody countries.

The hair and colour of these animals vary with the climate, and sometimes even in the same country. In France and Germany, beside the common wolves, we find some with thicker and more yellow coloured hair. These wolves, more wild, though less destructive, than the other kind, never trouble the flocks or the habitations of men, and live solely by hunting. In the northern countries, we meet with some wolves which are entirely white, and others entirely black; and the latter are larger and stronger than the former. The common species are very generally diffused: they are found in Asia, Africa, and America, as well as in Europe. The wolves of Senegal resemble those of France; but they are larger and more rapacious. The wolves of Egypt are smaller than those of Greece. In the East, and particularly in Persia, wolves are exhibited as spectacles to the people. When young they are taught to dance, or rather to perform a kind of wrestling with a number of men. Chardin tells us, that a wolf well educated in dancing, is sold at 500 French crowns. This fact proves, that these animals, by time and restraint, are susceptible of some kind of education. I have brought up several of them: when young, or during their first year, they are very docile, and even caressing; and if well fed, they neither disturb the poultry, nor any other animal. But at the age of 18 months or two years, their natural ferocity returns, and they must be chained, to prevent them from running off, and doing mischief. I reared one till the age of 18 or 19 months, in a court along

with fowls, none of which he ever attacked; but for his first essay he killed the whole in one night, without eating any of them. Another having broken his chain run off, after killing a dog with whom he had lived in great familiarity. I kept a she-wolf three years in a large court; and though shut up when very young along with a mastiff dog of the same age, she could never suffer him to approach even when she came in season. She provoked, she attacked, she bit the dog, who at first only defended himself, but at last he worried her.

There is nothing valuable in the wolf but his skin, which makes a warm durable fur. His flesh is so bad that it is rejected with abhorrence by all other quadrupeds; and no animal but a wolf will voluntarily eat a wolf. The smell of his breath is exceedingly offensive. As to appease hunger he swallows indiscriminately every thing he can find, corrupted flesh, bones, hair, skins half tanned and covered with lime, he vomits frequently, and empties himself oftener than he fills. In fine, the wolf is consummately disagreeable; his aspect is base and savage, his voice dreadful, his odour insupportable, his disposition perverse, his manners ferocious; odious and destructive when living, and when dead, he is almost perfectly useless.

SUPPLEMENT.

In the history of the wolf I omitted to remark, that this animal was extirpated in England. By way of recompense, it would appear, that these voracious creatures have found out new countries to inhabit. Pontoppidan alledges, that they existed not in Norway before the year 1718. He says, that during the last war between Sweden and Norway, the wolves passed the mountains by following the provisions of the army.

The Viscount of Querhoent, in his observations, tells us, that there are two species of wolves at the Cape of Good Hope, the one black, and the other gray with black spots. He adds. that they are stronger than those of Europe, and their skin is thicker, and their teeth more sanguinary; but that their dastardliness makes them less formidable, though, like the ounces, they sometimes during the night come into the streets of the city.

THE BLACK WOLF.

I DESCRIBE this animal only as a supplement to the article *Wolf;* for both, I am persuaded, belong to the same species. In the history of the wolf, it was remarked, that in the north of Europe there are some wolves which are white, and the others black, and that the black kind are the largest. The wolf represented in the plate was brought from Canada. It was totally black, but smaller than our wolf: its ears were somewhat larger, more erect, and at a greater distance from each other. The eyes were likewise a little smaller, and appeared to be more distant from one another than in the common wolf. These differences, in my opinion, are too inconsiderable to constitute a distinct species. The greatest difference is that of the size. But as I have oftener than once remarked, all the animals common to the northern parts of Europe and America differ in size; and the black wolf of Canada, which is smaller than those of Europe, only tends to confirm the general fact. Besides, as he had been taken when very young, and ever afterwards confined with a chain, constraint alone was perhaps sufficient to prevent him from acquiring his full growth. The common wolf is also smaller and less numerous in Canada than in Europe, and the savages esteem it for its skin. The black wolf, the lynx, and the fox, are very numerous in North America; and yet the black fox is very rare, and his skin is much more beautiful than that of the black wolf, which makes but a very coarse fur.

I shall only add, that this black wolf resembled the common wolf, both in figure and dispositions; for he became rapacious only with age, and, like the wolf, he was ferocious without courage.

THE FOX.

THE fox has a sharp nose, lively hazel eyes, sharp erect ears, body tawny red, mixed with ash-colour; fore part of the legs black; tail long, strait, bushy, tipt with white; subject to much varieties in colour.

The fox is famous for craftiness; and he merits, in some measure, the reputation he has acquired. What the wolf executes by force alone, the fox performs by address, and often with more success. Without combating dogs or shepherds, without attacking the flocks, or disinterring the bodies of the dead, the fox is more certain of procuring his food. He exerts more genius than motion, and all his resources are within himself. Acute as well as circumspect, ingenious, and patiently prudent, he diversifies his conduct, and always reserves some art for unforeseen accidents. Of his own preservation he is extremely vigilant. Though equally indefatigable, and even nimbler than the wolf, he trusts not entirely to the swiftness of his course. The fox knows how to ensure safety by providing himself with an asylum, where he retires from pressing dangers, where he dwells, and where he brings up his young. He is not a vagabond, but lives in a settled domestic state.

This difference, though it appears even among men, has greater effects, and supposes more powerful causes, among the inferior animals. The single idea of a house or settled place of abode indicates a singular attention to self. The choice of situation, the art of making and rendering a house commodious, and of concealing the avenues to it, imply a superior degree of sentiment. The fox is endowed with this quality, and manages it with advantage. He fixes his abode on the border of the wood, in the neighbourhood of cottages: he listens to the crowing of the cocks and the cries of the poultry. He scents them at a distance; he chooses his time with judgment; he conceals his road as well as his design; he slips forward with caution, sometimes even trailing his body, and seldom makes a fruitless expedition. If he can leap the wall, or get in underneath, he ravages the court-yard, puts all to death, and then retires softly with his prey, which he either hides under the herbage, or carries off to his kennel. He returns in a few minutes for another, which he carries off, or conceals in the same manner, but in a different place. In this way he proceeds till the progress of the sun, or some movements perceived in the house, advertise him that it is time to suspend his operations, and to retire to his den. He plays the same game with the catchers of thrushes, wood-cocks, &c. He visits the nets and bird-lime very early in the morning, carries off successively the birds which are entangled, and lays them in different places, especially near the sides of highways, in the furrows, under the herbage or brushwood, where they sometimes lie two or three days; but he knows perfectly where to find them when he is in need. He hunts the young hares in the plains, seizes old ones in their seats, never misses those which are wounded, digs out the rabbits in the warrens, discovers the nests of partridges and quails, seizes the mothers on the eggs, and destroys a vast quantity of game. The wolf is not more noxious to the peasant than the fox to the gentleman.

The chase of the fox requires less apparatus, and is more amusing, than that of the wolf. To the latter every dog has great reluctance; but all dogs hunt the fox spontaneously and with pleasure; for though his odour be strong, they often prefer him to the stag or the hare. He may be hunted with terriers, hounds, &c. Whenever he finds himself pursued, he runs to his hole; the terriers with crooked legs, or turnspits, go in with most ease. This mode answers very well when we want to carry off a whole litter of foxes, both mother and young. While the mother defends herself against the terriers, the hunters remove the earth above, and either kill or seize her alive. But as the holes are often under rocks, the roots of trees, or sunk too deep in the ground, this method is frequently unsuccessful. The most certain and most common method of hunting foxes is to begin with shutting up their hole, to place a man with a gun near the entrance, and then to search about with the dogs. When they fall in with him, he immediately makes for his hole; but when he comes up to it, he is met with a discharge from the gun. If he escapes the shot, he flies with full speed, takes a large circuit, and returns again to the hole, where he is fired upon a second time; but finding the entrance shut, he now endeavours to escape by darting straight forward, with the design of never revisiting his former habitation. He is then pursued by the hounds, whom he seldom fails to fatigue, because he puposely passes through the thickest parts of the forest or places of the most difficult access, where the dogs are hardly able to follow him; and when he takes to the plains, he runs straight out without stopping or doubling.

But the most effectual mode of destroying foxes is the laying of snares baited with a pigeon, a live fowl, &c

I once suspended on a tree, at the height of nine feet, some meat, bread, and bones. The foxes had been at severe exercise during the night; for next morning, the earth all around was beaten, by their jumping, as smooth as a barn floor. The fox is exceedingly voracious; beside flesh of all kinds, he eats with equal avidity, eggs, milk, cheese, fruits, and particularly grapes. When the young hares and partridges fail him, he makes war against rats, field-mice, serpents, lizards, toads, &c. Of these he destroys vast numbers; and this is the only service he does to mankind. He is so fond of honey, that he attacks the wild bees, wasps, and hornets. They at first put him to flight by a thousand stings; but he retires only for the purpose of rolling himself on the ground to crush them; and he returns so often to the charge, that he obliges them to abandon the hive, which he soon uncovers, and devours both the honey and wax. In a word, he eats fishes, lobsters, grasshoppers, &c.

The fox has a great resemblance to the dog, especially in his internal parts. His head, however, is larger in proportion to his body; his ears are also shorter, his tail thicker, his hair longer and more bushy and his eyes more inclined. He differs still more from the dog by a strong offensive odour which is peculiar to him, and by his natural disposition; for he is not easily, and never fully tamed: he languishes when deprived of liberty, and if kept too long in a domestic state, he dies of chagrin. He does not copulate with the female dog: if they have no rooted antipathy, they are at least indifferent to each other. Foxes produce but once a year; and the litter commonly consists of four or five, seldom six, and never less than three. When the female is full, she retires, and seldom goes out of her hole, where she prepares a bed for her young. She comes in season in the winter; and young foxes are found in the month of April. When she perceives that her retreat is discovered, and that her young have been disturbed, she carries them off one by one, and goes in search of another habitation. The young are brought forth blind; like the dogs, they grow 18 months, or two years, and live 13 or 14 years.

The senses of the fox are equally good as those of the wolf; his sentiment is more delicate; and the organs of his voice are more pliant and perfect. The wolf sends forth only frightful howlings; but the fox barks, yelps, and utters a mournful cry like that of the peacock. He varies his tones according to the different sentiments with which he is affected: he has an accent peculiar to the chase, the tone of desire, of complaint, and of sorrow. He has another cry expressive of acute pain, which he utters only when he is shot, or has some of his members broken; for he never complains of any other wound, and like the wolf, allows himself to be killed with a bludgeon without complaining; but he always defends himself to the last with great courage and bravery. His bite is obstinate and dangerous; and the severest blows will hardly make him quit his hold. His yelping is a species of barking, and consists of a quick succession of similar tones; at the end of which he generally raises his voice similar to the cry of the peacock. In winter, and particularly during frost and snow, he yelps perpetually; but in summer, he is almost entirely silent, and during this season, he casts his hair. The skins of young foxes, and of those taken in summer, are of little value. The flesh of the fox is not so bad as that of the wolf: dogs, and even men, eat it in autumn, especially when he has been fattened with grapes; and his skin in winter makes excellent furs. He sleeps sound, and may be easily approached without wakening; he sleeps in a round form, like the dog; but when he only reposes himself, he extends his hind legs, and lies on his belly. It is in this situation that he spies the birds along the hedges, who have such an antipathy to him, that they no sooner perceive him, than they send forth soft shrill cries to advertise their neighbours of the enemy's approach. The jays and black birds, particularly, follow the fox from tree to tree, sometimes two or three hundred paces, often repeating the watch-cries.

I brought up some young foxes: their offensive odour made it necessary to keep them in stables or places which were not much frequented. This, perhaps, might be one reason why they were less tame than the wolf, which was kept near the house. At the age of five or six months, the young foxes pursued the ducks and fowls; and therefore it became necessary to chain them. I kept two males and a female two years. I tried in vain to make the males copulate with bitches: though they had never seen females of their own species, and were stimulated by the strongest desires of Nature, they uniformly rejected the bitches. But whenever a she-fox was presented to them, though chained, they instantly covered her, and she brought forth four whelps. The young foxes, who, when at liberty had darted on the poultry, never attempted to touch a single fowl, after they were chained. A living hen was generally fixed near them for a whole night; and though victuals were kept from them for many hours; yet in spite of hunger and of opportunity, they never forgot that they were chained, and disturbed not the hen.

The fox is so extremely subject to the influences of climate, that the varieties of this species are almost as numerous as those of the domestic animals. Most of our foxes are reddish; but some of them are of a silver gray: in both, the end of the tail is white. In Burgundy, the latter are called coal foxes; because their feet are remarkably black. Their bodies have also the appearance of being shorter, because they are better clad with hair. There are some who are really longer

than the other kinds, and of a dirty gray colour, nearly the same with that of old wolves. But it is uncertain whether this difference constitutes a real variety, or is produced by the age of the animal, who perhaps grows whiter as he advances in years. In the northern regions, the foxes are of all colours, black, blue, gray, iron-coloured, silver gray, white, white with yellow feet, white with black heads, white with the extremity of the tail black, reddish with the throat and belly entirely white; and lastly, some of them have a black line along the spine, crossed with another black line over the shoulder. The latter are larger than the other kinds, and have black throats. The common species are more generally diffused than any of the others. We find them in every part of Europe, in the northern and temperate regions of Asia, and in America; but they are very rare in Africa, and in the countries bordering on the Equator. Travellers who pretend to have seen them in Calicut, and other southern provinces of India, have mistaken the jackal for the fox. Aristotle himself falls into a similar error, when he tells us, that the foxes of Egypt are smaller than those of Greece; for what he calls the small foxes of Egypt are polecats, whose odour is intolerable. Our foxes, which belong originally to cold climates, have spread over all the temperate regions, but have never penetrated farther south than Spain and Japan. What shows them to be natives of cold countries is, that all the varieties of the species are to be found in the high latitudes, and no where else: besides, they support with ease the most extreme cold, and live in the neighbourhood of both poles. The fur of the white foxes is not much valued, because the hairs fall easily off; the silver gray is better; and the blue and cross kinds are in great request, on account of their rarity; but the black is the most precious; next to that of the sable, it is the best and dearest fur. We find foxes in Spitzbergen, in Greenland, in Lapland, and in Canada. In the latter country, there are likewise crossed foxes; the common species is not so red as in Europe; and the hair is longer and more bushy.

SUPPLEMENT.

Travellers inform us, that the foxes of Greenland resemble dogs in the form of the head and feet, and likewise in their barking; that some of them are white but the greatest number gray or blue; that they seldom change their colour, and when the hair of the blue kind begins to fall off, it grows pale, and the fur is no longer valuable; that they live upon eggs and birds, and when they are unsuccessful in finding this species of food, they content themselves with flies, bees, crabs, and what they can procure by fishing; and that they dwell in the clefts of rocks.

At Kamtschatka, the hair of the fox is very bushy, and so glossy and beautiful, that it excels the finest Siberian furs. The most valuable are the black chesnuts, those with black bellies and red bodies, and those of an iron colour.

In Norway there are white, bay, and black foxes, and others which have two black lines on the reins. The latter kind, and those which are wholly black, are most esteemed. These furs are a considerable article of commerce; from the port of Bergen alone, more than 4000 foxes skins are annually exported. Pontoppidan, who often indulges in the marvellous, tells us, that a fox had ranked several heads of fishes into rows, at some distance from a fisher's hut; that the people could not imagine what might be his intention, but that a little afterwards, a crow, which lighted to feed upon the heads, fell a sacrifice to his cunning device. He adds, that these animals make use of their tail in catching lobsters, &c.

THE BADGER.

THE badger has six cutting teeth, and two canine in each jaw; five toes before, five behind, with very long straight claws on the fore feet; and a transverse orifice between the tail and the anus. He has small eyes, short rounded ears, a short thick neck, with nose, chin, lower sides of the cheeks, and middle of the forehead white; ears and eyes inclosed in a pyramidal bed of black, hairs on the body long and rude, their bottoms a yellowish white, middle black, ends ash-coloured; throat, breast, belly, and legs black; tail covered with long hairs, coloured like those of the body; legs very short and thick; claws on the fore feet very long; a fœtid white matter exudes from the orifice beneath the tail; an animal of a very clumsy make.

The badger is an indolent, diffident, solitary animal. He retires to the most secret places, to the inmost recesses of the forest, and there digs a subterranean habitation. He seems to fly society, and even the light, and spends three fourths of life in his dark abode, from which he never departs but in quest of subsistence.

As his body is long, his legs short, his claws, especially those of the fore feet, very long and strong, he digs and penetrates the earth with greater facility than any other animal. He makes his hole winding and oblique. The fox, who cannot dig with equal dexterity, avails himself of the operations of the badger: being unable to make him quit his habitation by force, the fox practises every art to render him uneasy: he stands sentinel at the entrance of the hole, and even defiles it with his ordure. He afterwards takes possession, enlarges, and fits it up for his own accommodation. The badger, though obliged to change his habitation, leaves not his country. He goes to a small distance only, where he digs a fresh hole, from which he removes not, except in the night; and as he never goes far, he returns upon the approach of danger. This is his only mean of safety; for he cannot escape by flight: his legs are too short for quick motion. When at some distance from his hole he is soon overtaken by the dogs. They seldom, however, accomplish their purpose without assistance. The hair of the badger is very thick, and his legs, jaws, teeth, and claws, are exceedingly strong. These natural weapons he uses with courage and dexterity: he lies on his back, resists all the efforts of the dogs, and wounds them in the most dangerous manner. He is besides very tenacious of life, fights long, makes a brave defence, and persists to the very last extremity.

Formerly, when badgers were more common, terriers were trained to hunt and to take them in their holes. The badger defends himself by retiring and throwing back the earth, in order to stop or bury the dogs. He can only be taken by opening the hole above, after the dogs have pushed him to its extremity. The people lay hold of him with pincers, and then muzzle him, to prevent his biting. I have kept some of them, which had been taken in this manner, a considerable time. The young ones are easily tamed; they play with the dogs, and follow the person who feeds them. But when taken old, they continue always savage. They are neither mischievous nor ravenous, like the fox and wolf; and yet they are carnivorous. They eat every thing presented to them, as flesh, eggs, cheese, butter, bread, fish, nuts, grain, roots, &c. But raw flesh they prefer to every other food. They sleep the whole night and three fourths of the day; and yet they are subject to a lethargic or benumbed state during winter, like the marmottes or dormice. This great quantity of sleep makes them fat, though they eat but little; and for the same reason they can support hunger with ease, and often remain in their holes three or four days together, especially during snow.

They keep their habitations extremely clean, and never defile them with their ordure. The male is seldom found with the female. When about to bring forth, she cuts down the herbage, bundles it up, and trails it with her feet to the bottom of the hole, where she makes a commodious bed for herself and her young. She brings forth in summer; and the litter commonly consists of three or four. When somewhat advanced, she brings them victuals. She now travels in the night to greater distances than formerly. She uncovers the earth from bee-hives, and carries off the honey; she rushes into the burrows of rabbits, and seizes their young; she likewise lays hold of field-mice, lizards, serpents, grasshoppers, and birds eggs, which she conveys to her offspring, whom she often leads to the mouth of the hole, in order to suckle or to feed them.

These animals are naturally chilly: those brought up in the house would never quit the corner of the fire, and often approach so near as to burn their feet, which do not readily heal. They are subject to the itch, and often infect the dogs which enter their holes, unless they be afterwards carefully washed. The hair of the badger is always rude and greasy. Between the anus and tail there is a pretty large fissure, penetrating about an inch deep, from which continually exudes an unctuous ill scented liquor, which the animal is fond of sucking. The flesh of the badger has not a very bad taste; and coarse furs, collars for dogs, coverings for horses, &c. are made of his skin.

We know of no varieties in this species: we have endeavoured, without success, to find the sow-badger spoken of by hunters. Du Fouilloux tells us, that there are two species of badgers, the sow and the dog-badger; and that the sow-badger is fatter, whiter, and grosser, both in the body and head, than the dog-badger. These differences are extremely trivial; and he acknowledges, that they are not to be perceived without an accurate inspection. This distinction I consider as a vulgar error, probably founded on the double name of this animal, both in Latin, viz. *meles* and *taxus*, and in French, viz. *blaireau* and *taisson*. Besides, those species which have varieties are commonly very numerous and generally diffused: that of the badger, on the contrary, is one of the least numerous and most limited. We are not certain that they exist in America, unless we regard as a variety the animal sent from New York, of which M. Brisson has given a short description under the name of the *white badger*. There are none in Africa; for the animal from the Cape of Good Hope, described by Kolbe, under the name of the *stinking badger*, is a different species; and it is doubtful whether the *Fossa*, of Madagascar, mentioned by Flacourt, who says it resembled the French badger, be a real badger, or some other animal. It has never been taken notice of by other travellers: Dr. Shaw even says, that the badger is totally unknown in Barbary. It seems likewise not to exist in Asia: it was not known to the Greeks; for Aristotle never mentions it, and the badger has no name in the Greek language. Hence this species

of quadruped, an original native of the temperate climates of Europe, has never spread beyond Spain, France, Italy, Germany, Britain, Poland, and Sweden; and it is every where very scarce. The badger admits not only of no varieties, but he even approaches not to any other species. His characters are deeply marked and very singular. The alternate belts upon his head, and the fissure under his tail, are perfectly peculiar; and his body is nearly white above, and almost black below, which is contrary to all other animals, whose bellies are always of a lighter colour than their backs.

THE OTTER.

THE otter has six cutting teeth, and two canine, in each jaw; five toes on each foot, each toe connected by a strong membrane. He has short ears, eyes placed near the nose, thick lips, and large whiskers. The whole colour of his body is of a deep brown, except two small spots on each side of the nose, and another below the chin: his legs are short, thick, loosely joined to the body, capable of being brought to a line with the body, and of performing the part of fins: each toe is connected to the other by a broad strong web. His length is 23 inches, and that of the tail 16.

The otter is a voracious animal, but fonder of fish than of flesh: he never quits the margins of rivers or of lakes, and often depopulates the fish ponds. He swims with more ease than the beaver; for the latter has membranes on his hind feet only, and the toes of his fore feet are separate; but the otter has membranes on all his feet. He swims almost as quick as he walks. He never goes to the sea like the beaver, but traverses the fresh waters and rivers to very considerable distances. He often swims under the water, and after remaining pretty long, ascends to the surface for air. Properly speaking, he is not an amphibious animal, or an animal that can live equally in air and in water. He is not formed for continuing in the latter element; for, like other terrestrial creatures, he requires the aid of respiration. When in pursuit of a fish, if he chances to be entangled in a net, he drowns; and we perceive that he has not had time to cut a sufficient quantity of the meshes to effectuate his escape. His teeth resemble those of the martin, but they are proportionally longer and stronger. For want of fishes, crabs, frogs, water rats, or other food, he gnaws the young twigs, and eats the bark of aquatic trees; he likewise eats the young herbage in the spring. He is neither afraid of cold nor of moisture. The female comes in season in winter, brings forth in March, and the litter consists of three or four. Young animals are generally beautiful; but the young otter is not so handsome as the old. A head ill-shaped, ears placed low, eyes small and covered, a lurid aspect, awkward motions, an ignoble and deformed figure, and a kind of mechanical cry which he repeats every moment, seem to indicate a stupid animal. The otter however acquires industry with age, sufficient at least to carry on a successful war against the fishes, who, both with regard to sentiment and instinct, are much inferior to other animals. But I can hardly allow him to have the talents of the beaver, or even the habits ascribed to him, such as that of always ascending the rivers, in order to swim the more easily down the current, when loaded with his prey; that of fitting up and flooring his house to exclude the water; that of hoarding a store of fishes, in case of a scarcity; and lastly, that of being easily tamed, of fishing for his master, and even bringing the fish into the kitchen. All I know is, that the otters dig no habitations for themselves; that they take possession of the first hole they find under the roots of poplars or willows, in the cliffs of rocks, and even in piles of floating wood; that they deposit their young on beds made of twigs and herbs; that we find in their habitations heads and bones of fishes; that they often change their places of abode; that they banish their young at the end of six weeks or two months; that those I attempted to tame endeavoured to bite, though they were only taking milk, and unable to eat fish; that some days after they became more gentle, perhaps because they were weak or sick; that so far from being easily accustomed to a domestic life, all of them which I attempted to bring up died young; that the otter is naturally of a savage and cruel disposition; that when he gets into a fish pond, he is equally destructive as the polecat in a hen-house; that he kills many more fishes than he can eat, and then carries off one in his mouth.

Though the otter does not cast his hair, his skin is browner, and sells dearer in winter than in summer; it makes a very fine fur. His flesh has a disagreeable fishy taste. His retreats exhale a noxious odour from the remains of putrid fishes; and his own body has a bad smell. The dogs chase the otter spontaneously, and easily apprehend him when at a distance from water or from his hole.

But when seized, he defends himself, bites the dogs most cruelly, and sometimes with such force as to break their leg-bones, and never quits his hold till death looses his jaws. The beaver, however, which is not a very strong animal, pursues the otters, and permits them not to live upon the banks he possesses.

This species, though not very numerous, is spread over Europe from Sweden to Naples; and we find them even in North America. They were well known to the Greeks, and probably extend over all the temperate climates, especially in places which abound with water; for the otter can neither dwell in burning sands, nor in dry deserts. He equally flies barren rivers, and those that are too much frequented. I believe none of them are to be found in very warm countries; for the jiya or carigueibeju, which is found at Cayenne, and has been named the Brasilian otter, appears to be a different species: whereas the North American otter resembles the European in every article, except that his fur is blacker and finer than that of the Swedish or Muscovite otter.

SUPPLEMENT.

Pontoppidan assures us, that in Norway, the otters frequent the salt as well as the fresh waters; and that they live among the fragments of rocks, from which the hunters decoy them by imitating their voice, which consists of a low kind of whistle. He adds, that they eat only the fat parts of fishes; and that a tamed otter, which was fed with milk, brought fish daily to the house.

In some notes communicated by M. de la Borde, I find that there are three species of otters in Cayenne; the black, which weighs 40 or 50 pounds; the yellowish, which weighs 20 or 25 pounds; and the small grayish kind, which weighs not above three or four pounds. He further remarks, that these animals are very frequent in Guiana, along the rivers and marshes where fishes abound: they sometimes appear in numerous troops, and are so fierce that they cannot be approached. Their bite is cruel, and they defend themselves against the dogs. They litter in holes which they dig in the banks. They are often tamed and brought up in houses. I have remarked, says M. de la Borde, that all the animals of Guiana are easily accustomed to a domestic state, and become even troublesome by their familiarity.

M. Aublit, a learned botanist formerly quoted, and M. Olivier, surgeon to the King, who have long resided in Cayenne, affirm, that there are otters in that country so large, that they weigh 90 or 100 pounds. They live in the great and unfrequented rivers, and their heads often appear above the water. Their cry is heard at great distances; their hair is very soft, but shorter than that of the beaver, and generally of a dark brown colour. They live upon fishes, and eat likewise the grains which fall into the water from the banks of the rivers.

THE MARTIN.

THIS animal has broad rounded ears, lively eyes, a brown head, tinged with red; the body, sides, and legs, are covered with hair, ash-coloured at the bottoms, bright chesnut in the middle, and black at the tips; the throat and breast are white, and the belly deep brown; the tail is full of hair, and of a dusky colour; the feet are broad, and covered at bottom with thick down; the claws are white; and the length of the body is eighteen inches, and of the tail ten.

Most naturalists have described the martin and the pine-weasel, or yellow breasted martin, as animals of the same species. Gesner and Ray, in imitation of Albertus, affirm that they intermix promiscuously. This fact, however, which is supported by no other evidence, appears at least to be doubtful: I believe on the contrary, that these animals have no intercourse, but form two distinct and independent species. To illustrate this point, I shall give a few reasons. If the pine-weasel were only a wild martin, or the martin a domestic pine-weasel, the first would constantly preserve the same characters, and the latter would be subject to variations; as the wild cat uniformly remains the same, while the domestic cat assumes all sorts of colours. The martin, on the contrary, never varies, but preserves its peculiar characters as constantly as the pine-weasel retains those which are proper to it. This alone is a sufficient proof that these two animals are specifically different, and that the one is not a simple variety of the other. Besides, there is no reason for regarding the martin as a domestic animal: he is no more domestic than the fox or the polecats, which, like him approach the habitations of men in quest of their prey; and he has no greater communication with mankind than the other animals we call wild or savage. The martin, therefore, differs from the pine-weasel both in disposition and temperament; for the latter flies the open fields, lives in the most secret

recesses of the forest, and is never numerous in cold climates: but the martin approaches our habitation, takes up his abode in old buildings, in hay-lofts, and in holes of the walls. The species is likewise spread in great numbers over all the temperate countries, and is even found in warm regions, as in Madagascar, and the Maldiva islands, and is never seen in high latitudes.

The martin has a fine countenance, a lively eye, supple limbs, and a flexible body. His movements are all exceedingly nimble; he rather bounds and leaps, than walks. He climbs rough walls with ease and alacrity; enters the pigeon or hen-houses, eats the eggs, pigeons, fowls, &c. and the female often kills great numbers, and transports them to her young. He likewise seizes mice, rats, moles, and birds in their nests. I kept one of these animals a considerable time. He tamed to a certain degree; but never formed any attachment, and continued always so wild that it was necessary to chain him. He made war against the rats, and attacked the poultry, whenever they came in his way. He often got loose, though chained by the middle of the body. At first he went to no great distance, and returned in a few hours, but without discovering any symptoms of joy, or of affection to any particular person. He, however, called for victuals like a cat or a dog. Afterwards he made longer excursions, and at last, he thought proper never to return. He was then about a year and a half old, seemingly the age at which nature assumes her full ascendancy. He eat every thing presented to him, except salad and herbs. He was fond of honey, and preferred hemp-seed to every other grain. We remarked, that he drank very often; that he sometimes slept two days successively; that at other times he would sleep none for two or three days; that before sleeping, he folded himself in a round form, and covered his head with his tail; and that while awake, his motions were so violent, so perpetual, and so incommodious, that though he had not disturbed the fowls, we found it necessary to chain him, to prevent him from breaking every thing. We have had in our possession several other martins of a more advanced age, which had been taken in nets; but they continued to be totally savage, bit all who attempted to touch them, and would eat nothing but raw flesh.

Martins, it is said, go with young as long as cats. We meet with young ones from spring to autumn; and therefore it is probable that they bring forth more than once a-year. The younger females litter only three or four at a time; but the more aged produce six or seven. When about to bring forth, they take up their abode in magazines of hay, in holes of walls, which they stuff with straw and herbs, in clefts of rocks, or in the hollow trunks of trees; and when disturbed, they remove their young, who seem to arrive very soon at maturity; for the one I kept had nearly attained its full growth in one year; hence we may conclude, that those animals live eight or ten years only. They have a kind of musky smell, which is not very disagreeable. The pine-weasel and the martin, like some other animals, have two vesicles, one on each side of the extremity of the rectum, which contain an odoriferous matter, similar to that procured from the civet cat. Their flesh retains a little of this odour; and yet that of the pine-weasel is not bad. The flesh of the martin is more disagreeable, and his skin is likewise much less valuable.

SUPPLEMENT.

The martin of Guiana is three or four inches longer than the European; but the tail is proportionally shorter. The muzzle seems also to be longer; it is black, and the blackness extends above the eyes, passes under the ears along the neck, and loses itself in the brown hair of the shoulders. There is a large white space above the eyes, which spreads upon the front, surrounds the ears, forms a narrow band along the neck, and disappears on the shoulders. The ears are perfectly similar to those of the martin. The top of the head is gray, mixed with white; the neck is brown interspersed with ash-coloured hairs; and the body is covered with a mixture of white and blackish hairs. These hairs are gray and ash-coloured at their origin, then brown, and black and white at the extremities. The under part of the jaw is of a blackish brown colour, which extends under the neck, and vanishes towards the belly, which is of a bright brown or chesnut. The legs and feet are covered with shining reddish black hair; and the toes have a greater resemblance to the toes of the squirrel and rat than to those of the martin. The great toes of the fore-feet are four lines long; but those of the hind-feet only two. The tail is more bushy at the origin than the extremity, and the hair of it is chesnut or a bright brown mixed with black.

THE PINE-WEASEL, OR YELLOW-BREASTED MARTIN.

WEASEL with a yellow breast and throat; the hair is of a dark chesnut colour, and of far superior fineness to the former; but in other respects agreeing with it.

This animal is a native of northern regions, where the species is so numerous, that the quantity of their furs annually consumed is perfectly astonishing. There are very few of them in the temperate climates, and they exist not in very warm countries. Some of them are found in the forests of Burgundy, and likewise in those of Fountainbleau; but in general, they are as rare in France as the martin is frequent. There are none of these animals in Britain; because they have no extensive forests in that country. They fly equally inhabited countries and uncovered fields. They dwell in the woods, and conceal not themselves among the rocks, but traverse the forest and climb the trees. They live by hunting, and destroy prodigious quantities of birds by eating their eggs. They seize squirrels, field-mice, &c. They also eat honey, like the martin and polecat. They never appear in the open fields, in the meadows, or in the vineyards. They approach not the dwellings of men; and they differ still farther from the martin in their manner of making their escape from the hunters. When the martin is pursued by a dog, he instantly runs to his hay-loft or his hole. The pine-weasel, on the contrary, runs a long time before the dogs, then climbs the trunk of a tree, and from this station he views them as they pass. The track which he leaves in the snow appears to be that of a large animal, because he always leaps, and both feet make but one impression. He is somewhat larger than the martin, and yet his head is shorter. His legs are longer, and consequently he runs more easily. His neck is yellow; but that of the martin is white. His hair is finer, more bushy, and less subject to fall off. The female prepares not a bed for her young; and yet lodges them most commodiously. The squirrels build nests in the tops of trees with equal art as the birds. When the pine-weasel is about to bring forth, she climbs to the squirrel's nest, banishes the possessor, enlarges the entry to it, and there deposits her young. She likewise uses the old nests of ducks or buzzards, and holes of ancient trees, from which she dislodges the wood-peckers and other birds. She brings forth in the spring, and her litter consists of two or three only. Though her young come into the world blind, they soon acquire a considerable growth. She brings to them eggs and birds; and afterwards leads them out to hunt along with herself. The birds are so well acquainted with their enemies, that when they perceive the pine-weasel, they utter the same mournful cry to advertise his approach, as when they see a fox. What shows that the birds are animated with hatred rather than fear is, that they follow at a distance, and utter this peculiar cry against all carnivorous animals, as the wolf, the fox, the pine-weasel, the wild cat, &c. but never against the stag, the roe, the hare, &c.

The pine-weasels are very frequent in the northern parts of America, Europe, and Asia. Many of them are brought from Canada, and they extend as far as Hudson's bay; and in Asia, as far north as the kingdom of Tonquin and the empire of China. They ought not to be confounded with the sable, an animal whose fur is much more precious. The sable is black; but the pine-weasel is brown and yellow. The most valuable part of the skin of the latter is the brown, which extends along the whole back to the extremity of the tail.

THE POLECAT.

THE polecat has the space round the mouth, and the tips of the ears white; the head, body, and legs, of a chocolate colour, almost black; on the sides, the hairs are of a tawny cast, and the tail is black; the length of the body is 17 inches and of the tail 6.

The polecat has a great resemblance to the martin in temperament, disposition, manners, and figure. Like the latter, he approaches our habitations, mounts on the roofs, takes up his abode in hay-lofts, barns, and unfrequented places, from which he issues during the night

only in quest of prey. He steals slily into the court-yards, voleries, and pigeon-houses, where, with less noise than the martin, he makes greater havock, cutting off the heads of all the fowls, and then transporting them one by one to his magazine. If, as frequently happens, he cannot carry them off entire, on account of the smallness of the entry to his hole, he eats the brains, and takes only their heads along with him. He is likewise very fond of honey, attacks the hives in winter, and forces the bees to abandon them. He never retires far from the abodes of men. The spring is their season of love: the males fight for the female on the roofs of houses. They afterwards leave her, and go to pass the summer in the fields or in the woods. The female, on the contrary, continues in her habitation till she brings forth, and does not lead off her young till toward the end of the summer. She litters three or four, and sometimes five, suckles them but a short time, and accustoms them early to eat blood and eggs.

In the villages they live upon poultry; and in the country they hunt for prey. During the summer they take up their abode in rabbit-holes, in the cliffs of rocks, or in the hollow trunks of trees, from which they issue out in the night, and roam about the fields and woods, searching for the nests of partridges, larks, and quails. They climb trees in quest of the nests of other birds. They lie in watch for rats, field-mice, and moles; and carry on a perpetual war against the rabbit, who cannot escape them, as they enter with ease into his hole. A single family of polecats is sufficient to destroy a whole warren. This would be a simple method of diminishing the number of rabbits in places where they are too abundant.

The polecat is somewhat less than the martin: his tail is also shorter, his muzzle sharper, and his hair blacker and more bushy: he has white hair on his front, and likewise on the sides of the nose and round the mouth. He differs still more from the martin in his voice; the martin has a sharp piercing cry; the cry of the polecat is more blunt. Each of them, as well as the pine-weasel and squirrel, have a deep grunting tone, which they repeat often when irritated. Lastly, the odour of the martin is very different from that of the polecat, which, instead of being agreeable, is extremely fœtid; and from this circumstance the animal acquired its Latin name *putorius*. He sends forth this insupportable odour to a great distance, especially when irritated. The dogs will not eat the flesh of the polecat; and even his skin, though good, is in no estimation, because it never loses entirely its natural smell. This odour proceeds from two vesicles near the anus, from which an unctuous matter continually exudes; and the effluvia of it is extremely offensive in the polecat, ferret, weasel, badger, &c.; but it constitutes, on the contrary, a species of perfume, in the civet-cat, pine-weasel, martin, &c.

The polecat seems to be confined to the temperate climates: few or none of them are found in the northern regions; and in warm countries they are still more rare than the pine-weasel. The meles Surinamensis, or stifling weasel, is an animal of a different species; and the polecat appears to be bounded, in Europe, from Italy to Poland. This animal, it is certain, avoids the cold; for in winter he retires into the houses, and his steps are never seen in the snow, either in the woods or in fields which are distant from the habitations of men; he perhaps is equally averse to great heat; for he is never found in warm climates.

THE FERRET.

THIS animal has a very sharp nose, red fiery eyes, and round ears; the colour of the whole body is a very pale yellow; its length is about 14 inches, and that of the tail 5.

Whether the ferret and polecat belong to different species has been a subject of doubt with some naturalists. The resemblance of colour in some ferrets to that of the polecat may have given rise to this doubt. The polecat however is a native of temperate climates, and is a wild animal like the martin. But the ferret is a native of warm countries, and cannot subsist, even in France, unless in a domestic state. The ferret alone is used in hunting rabbits, because he is more easily tamed than the polecat. Both indeed have a strong and disagreeable odour. But the most convincing proof of their being different animals is, that they have no intercourse with one another, and differ in number of essential characters. The body of the ferret is thinner and more lengthened, his head narrower, and his muzzle sharper, than those of the polecat. He is not endowed with the same instinct in finding subsistence, but, at least in our climates, must be carefully nourished within doors, and cannot exist in the fields; for those which are lost in the burrows of rabbits never multiply, but probably perish during the winter. The ferret also, like other domestic animals, varies in colour; and

is equally common in warm regions, as the polecat is rare.

The female ferret is less than the male: when in season, she is so extremely ardent, that we are assured she dies if her desires are not gratified. Ferrets are brought up in casks or boxes, where they are furnished with beds of hemp or flax. They sleep almost continually. Whenever they awake, they search eagerly for food, which consists of bran, bread, milk, &c. They produce twice every year: the female goes six weeks with young: some of them devour their young as soon as they are brought forth, instantly come again in season, and have three litters, which generally consist of five or six, and sometimes seven or eight, and even nine.

This animal is by nature a mortal enemy to the rabbit. Whenever a dead rabbit is for the first time presented to a young ferret, he flies upon it, and bites it with fury; but if it be alive, he seizes it by the throat or the nose, and sucks its blood. When let into the burrows of rabbits, he is muzzled, that he may not kill them in their holes, but only oblige them to come out, in order to be caught in the nets. If the ferret is let in without a muzzle, he is in danger of being lost; for after sucking the blood of the rabbit, he falls asleep; and even smoking the hole is not a certain method of recalling him; because the holes have often several entries which communicate with each other, and the ferret retires into one of these, when incommoded with the smoke. Boys likewise use the ferret for catching birds in the holes of walls or of old trees.

According to Strabo, the ferret was brought from Africa into Spain; which is by no means improbable, as Spain is the native climate of rabbits, and the country where formerly these animals most abounded. It may therefore be presumed, that in order to diminish their number, which perhaps was incommodious, ferrets were imported for the purpose of hunting rabbits in a profitable manner, instead of multiplying martins, which would have destroyed the rabbits without bringing any advantage to the hunters.

The ferret, though easily tamed and rendered docile, is extremely irascible. His odour is always disagreeable; but when irritated, it becomes much more offensive. His eyes are lively, and his aspect is inflammatory; all his movements are nimble, and he is at the same time so vigorous, that he can easily overcome a rabbit, though at least four times larger than himself.

Notwithstanding the authority of commentators, it is still uncertain whether the ferret be the *ictis* of the Greeks. 'The ictis,' says Aristotle, 'is a species of 'wild weasel, smaller than the little Maltese dog, but 'resembling the weasel in its hair, in the whiteness of 'the under part of the body, and likewise in the crafti-'ness of its manners. It admits of being tamed; and 'makes great havock among the bee-hives, being ex-'tremely fond of honey. It also attacks birds, and like 'the cat has an osseous penis.' 1. There appears to be a contradiction in saying that the ictis is a species of wild weasel, which admits of being tamed; for the common weasel, which in this country is the most savage of the two, is perfectly irreclaimable. 2. The ferret, though larger than the weasel, can never be compared for size, to the lap-dog. 3. The ferret appears not to have the cunning of the weasel, nor indeed any craftiness at all: lastly, he never attacks the bee-hives, nor is he fond of honey. I inquired of M. le Roi, inspector of the royal chases, concerning this last fact. His answer follows: 'M. de Buffon may be assured, 'that the ferrets have no predilection for honey; but 'when hungry, may be made to eat it. I have fed 'them several days with bread soaked in water mixed 'with honey. The two last days, they eat it in pretty 'large quantities; but the weakest of them began to be 'sensibly emaciated.' This is not the first time that M. le Roi has obliged me with important facts. Having no ferrets, I tried the same experiment on the ermine, by giving him only pure honey to eat, and a little milk for drink: but he died in a few days. Thus neither the ermine nor the ferret are fond of honey, like the ictis of the ancients; which inclines me to think, that the word *ictis* is perhaps only a generic name; or if it marks any particular species, it ought rather to be applied to the martin or polecat, both of which possess the craftiness of the weasel, attack the bee-hives, and are extremely fond of honey.

THE WEASEL.

THE weasel has small rounded ears; the whole upper part of the body is of a tawny brown colour, and the under part is entirely white. It has a brown spot beneath the corners of the mouth. The length of its body is between six and seven inches, and of the tail two and a half.

The weasel is as common in temperate and warm climates, as it is rare in the northern regions. The ermine, on the contrary, abounds in the north, is seldom met with in temperate climates, and never in warm countries. These animals therefore form two distinct species. The common weasel sometimes turns white during the winter, even in our climate. This circumstance might give rise to its being regarded as of the same species with the ermine. This mark is common to both: but there are others in which they differ. The ermine is reddish in summer, and white in winter; but the end of its tail is uniformly black. The end of the weasel's tail is yellow, even when the animal turns white in winter. It is, besides, always of a smaller size, and its tail is much shorter than that of the ermine. The weasel dwells not, like the ermine, in woods and deserts, but near the habitations of men. I have kept both species together; but animals which differ in climate, in constitution, and in disposition, never intermix. It is true, some weasels are larger or smaller than others; but the difference never exceeds an inch in the whole length of the body. But the ermine is two inches longer than the largest weasel. Neither of them can be tamed, but are kept wild in iron cages. Neither of them voluntarily eat honey, nor attack the bee-hives, like the polecat and martin. Thus the ermine is not the savage weasel, nor the ictis of Aristotle, which, he says, is easily tamed, and very fond of honey. The weasel and ermine, instead of being easily tamed, are so wild, that they will not eat when any person looks at them: they are in perpetual agitation, always endeavouring to conceal themselves: and if a man wants to keep them, he must furnish them with a bundle of wool or flax, in which they wrap and hide themselves from the light. Thither they drag every thing they can lay hold of, and never eat but in the night. They allow fresh meat to lie three or four days, and even till it corrupt, before they touch it. They sleep three-fourths of the day, and watch their prey during the night. When a weasel gets among the poultry, he attacks not the cocks or old hens, but singles out the chickens and young birds, whom he kills with a single bite on the head, and then carries off the whole one by one. He likewise breaks the eggs, and sucks them with incredible avidity. In winter, they generally live in granaries and barns, where they often remain during the spring, and bring forth their young among the hay and straw. During this period the female makes war, with more success than the cat, against the rats and mice, who cannot escape her, because she follows them into their holes. She mounts the pigeon houses, and destroys the pigeons, sparrows, &c. In summer, they retire farther from houses, especially into low grounds, about mills, along rivulets, conceal themselves among brushwood, in order to surprise birds, and often take up their abode in old willows, where the female brings forth her young: she prepares for them a bed of straw, leaves, and other herbage, and litters, in the spring, from three to five. The young, like those of the polecat, pine-weasel, and martin, are brought forth blind; but they very soon acquire growth and strength enough to follow their mother in the chase. The weasels attack serpents, water-rats, moles, field-mice, &c. and overrunning the meadows, they devour quails and partridges, together with their eggs. Their motion consists of unequal and precipitate leaps; and when they want to mount a tree, they make a sudden bound, by which they are at once elevated several feet high. They leap in the same manner when they attempt to seize a bird.

These animals, as well as the polecat and ferret, have a disagreeable odour, which is stronger in summer than in winter; and when pursued or irritated, their smell is felt at a considerable distance. They move always with caution and with silence, and never cry but when they are hurt. Their cry, is sharp, rough, and very expressive of resentment. As their own odour is offensive, they seem not to be sensible of a bad smell in other bodies. A peasant in my neighbourhood took three new-littered weasels out of the carcase of a wolf that had been hung on a tree by the hind feet. The wolf was almost entirely putrified, and the female weasel had made a nest of leaves and herbage for her young in the thorax of this putrid carcase.

SUPPLEMENT.

The author here ingenuously quotes a letter he received from the Countess of Noyan, dated at the Castle of Manceliere in Brittany, July 20, 1771, in which that lady assures him, that he had injured the character of the weasel, by alledging that no art could reclaim or render him docile; because she had tried the experiment upon a young weasel taken in her garden, which soon learned to recognise and to lick the hand from which it received its food, and became as familiar, caressing, and frolicksome, as a dog or squirrel.

This fact the author had still farther confirmed, by a similar experiment made by M. Giely de Mornas, who trained a young weasel so completely, that the animal followed him wherever he went. The method of taming them is to stroke them often and gently over the back, and to threaten, and even beat them, when they bite. Their odour is never offensive but when they are irritated. They are fed with milk, boiled flesh, and water; and unless they be starved never eat honey, although presented to them.

THE ERMINE.

THE upper part of the body is of a pale tawny brown colour, the edges of the ears and ends of the toes of a yellowish white; the throat, breast, and belly white; the end of the tail black: the length of the body is ten inches, and of the tail five and a half. In the north of Europe this animal becomes entirely white at the approach of winter, except the end of the tail; and it resumes its brown colour in the spring.

The weasel with a black tail, is called the *ermine*, and *roselet* by the French; the *ermine* when it is white, and the *roselet* when it is red or yellowish. Though less frequent than the ordinary weasel, they are still found in considerable numbers, especially in the ancient forests, and sometimes, during winter, in fields bordering upon woods. It is easy, at all seasons, to distinguish them from the common weasel; for the end of their tail is always of a deep black, and the borders of the ears and toes are white.

We have little to add to what we formerly remarked concerning this animal. We shall only observe, that it changes its colour as usual in winter. I had one sent me, in the beginning of March 1757, which was then white. I kept it till April 1758, when it would probably have become white had it been at liberty; but it was confined in an iron cage, against the bars of which it perpetually rubbed, and as it had not been sufficiently exposed to the cold, it still preserved its summer coat. It remains as savage as ever, and has lost nothing of its bad smell. In every other circumstance it is a healthy vivacious animal, has lively eyes, a fine countenance, and movements so rapid, that it is impossible to follow them with the eye. It has always been fed with eggs and flesh; but it touches not meat till it has become putrid. It never inclined to eat honey; and being deprived of victuals for three days, it died, after having taken a small quantity of honey. The skin of this animal is very precious. The furs of the ermine are finer and fairer than those of the white rabbit; but they soon turn yellowish; and indeed the ermines of our climate have always a slight tincture of yellow.

This animal is very frequent in the north, especially in Russia, Norway, and Lapland, where, as in every other place, they are reddish in summer and white in winter. They feed upon small animals, and particularly a species of rat which abounds in Norway and Lapland, to be afterwards mentioned. The ermines are rare in temperate climates, and are never found in warm countries. The Cape animal, called the *ermine* by Kolbe, and whose flesh, he remarks, is wholesome and agreeable to the palate, has no affinity to the ermine. The weasels of Cayenne, described by M. Barrere, and the gray ermines of Tartary, and of the northern parts of China, mentioned by some travellers, are also animals different from our weasels and ermines.

SUPPLEMENT.

In the natural history of Norway by Pontoppidan we have the following remarks.

'In Norway the ermine lives among the fragments of 'rocks. This animal seems to belong to the weasel 'tribe. His skin is white, except the tail, which is 'spotted with black. The furs of Norway and Lapland 'preserve their whiteness better than those of Russia, 'which sooner turn yellowish; and for this reason the 'former are of greater request, even at Petersburg. The 'ermine catches mice like the cat, and when practicable 'carries off his prey. He is particularly fond of eggs, 'and when the sea is calm he swims over to the islands 'which lie near the coast of Norway, where there are 'vast quantities of sea fowls. It is alledged, that when 'the female brings forth on an island, she conducts her 'young to the continent upon a piece of wood, piloting 'them with her snout. This animal, though small, 'kills those of a much larger size, as the rein-deer and 'bear. He jumps into one of their ears when they are 'asleep, and adheres so fast by his teeth that the crea-'tures cannot disengage him. He likewise surprises 'eagles and heath-cocks, by fixing on them and never 'quitting them, even when they mount in the air, till 'the loss of blood makes them fall down.'

THE GRISON, OR GRAY WEASEL.

THIS animal is analogous to the weasel and ermine. M. Allemand gave the first description of it under the name of the *grison*, in the 15th volume of the Dutch edition of my work, which he describes in the following manner:

'I received,' says he, 'from Surinam the small ani-

'mal called the *gray weasel*, from which circumstance 'I derived the name *grison*, because I know not how it is 'denominated in the country where it is found. The 'whole upper part of its body is covered with deep brown 'hair, having white points, which gives a grayish brown 'colour: under the head and neck is a bright gray, be-'cause the hairs there are very short, and the white 'part is of equal length with the brown. The muzzle, 'and the under part of the body and legs are black; 'which singularly contrasts with the gray colour on the 'head and neck.

'The head of this animal is very large in proportion 'to its body; its ears form almost a semicircle; its eyes 'are large; and its mouth is armed with strong grinders 'and sharp tusks. It has six cutting teeth in each jaw, 'four of them hardly rising above the gums. Both the 'fore and hind feet have five toes with yellowish claws. 'The tail is pretty long, and terminates in a point.

'The grison has a greater resemblance to the weasel 'than to any other animal. But it belongs not to the 'weasel tribe; for its body is too short, and its legs are 'too long. It is not mentioned by any author or tra-'veller. I shewed it to several persons who had lived 'long in Surinam; but none of them knew it; hence 'it either must be a rare animal, even in its native country, 'or it must live only in desert and unfrequented places. 'The length of its body is about seven inches. I have not 'been able to learn any thing of its history.

THE SQUIRREL.

THE common squirrel has two cutting teeth in each jaw; four toes before, and five behind; a long tail, cloathed with long hair; the ears terminated in long tufts of hair; the eyes are large, lively, and black; the head, body, legs, and tail, are of a bright reddish brown; the breast and belly are white; and the hair on each side of the tail lies flat.

The squirrel is a little neat animal, and may be considered as in a state between savage and domestic. The gentleness, docility, and inoffensiveness of his manners, entitle him to regard and protection. Though he sometimes seizes birds, he is neither carnivorous nor destructive. Fruits, almonds, nuts, beech-mast, and acorns, are his common food. He is handsome, lively, alert, and extremely vigilant and industrious. He has eyes full of fire, a fine countenance, a nervous body, and very nimble limbs. The beauty of his figure is heightened by a tail resembling a plume of feathers, which he raises the length of his head, and under which he shades himself from the sun and weather. The under part of his body is furnished with an apparatus equally remarkable, and which indicates strong generative powers. The squirrel partakes less of the nature of quadrupeds than most others of that tribe. He generally rests almost on end, and uses his fore feet like hands, in carrying his food to his mouth. Instead of concealing himself under the earth, he is perpetually in the air. He approaches the birds by his lightness; and like the feathered tribes, he dwells on the tops of trees, and traverses the forests by leaping from one tree to another. He likewise builds his nest in the trees, gathers grains and seeds, drinks the dews, and descends not to the earth but when the trees are agitated by storms. He is never found in the open fields nor in the plains. He approaches not the habitations of men, and never remains among brush-wood; but delights in the lofty trees of the forest. Of water he is still more afraid than of the earth; and we are assured, that when he wants to pass a river or lake he employs the bark of a tree for a ship, and uses his tail for the rudder and sails. He sleeps not, like the dormouse, during the winter, but is at all seasons awake and lively; and if the foot of the tree where he reposes be touched, he instantly leaves his little nest, and flies to another tree, or shelters himself under a branch. He collects nuts during summer, hides them in the trunks or hollows of old trees, and has recourse to them for his winter food: he likewise searches for them in the snow, and scratches off the surface of it with his feet. His voice is shrill, and still more piercing than that of the martin. When irritated, he makes a murmuring or grumbling noise. He is too light for walking; his movements consist of little leaps; and sometimes he makes considerable bounds. His claws are so sharp, and his motions so quick, that he instantaneously climbs the highest beech trees, though their bark be exceedingly smooth.

During the fine summer nights, the squirrels are heard crying, when pursuing each other among the trees. They seem to dread the heat of the sun; for during the day, they remain in their nests, from which they issue in the night, to eat, to frolic, and to make love. Their habitation is clean, warm, impenetrable to rain, and generally situated in the cleft of a tree. They begin the work by carrying small sticks, which they mix and interlace with moss: they then press and stamp it, to give it firmness and capacity for holding themselves and their

young. A small straight aperture only is left near the top, which is hardly sufficient to allow them to pass. Above this aperture is a conical cover which shelters the whole, and makes the rain run off the sides. They generally produce three or four at a litter: the females come in season in the spring, and bring forth in May, or the beginning of June. They cast their hair in winter, and the new fur is redder than the former. They comb and dress themselves with their hands and teeth, are very cleanly, and have no bad smell. Their flesh makes pretty good eating. The hair of their tail is used for pencils; but their skin is only an indifferent fur.

Several species of quadrupeds border upon that of the squirrel; but there are few varieties in the species itself. Some are of an ash-colour; but the greatest number are reddish. The small gray kind is a different species, and continues always gray: and without mentioning the flying squirrels, the white squirrel of Cambaia, which is very small, that of Madagascar, called *Tsitsihi*, which is gray, and neither beautiful nor easily tamed, the white squirrel of Siam, the gray spotted squirrel of Bengal, the striped squirrel of Canada, the black squirrel, the large gray squirrel of Virginia, the squirrel of New Spain, with white stripes, the white squirrel of Siberia, the variegated squirrel, or *mus ponticus*, the small American squirrel, that of Brasil, that of Barbary, the palm-rat, &c. form so many distinct and independent species of quadrupeds.

SUPPLEMENT.

Squirrels should be considered rather as natives of northern regions, than of temperate climates; for they abound so much in Siberia, that immense numbers of their skins are annually sold in that country. The Siberians, says M. Gmelin, take the squirrels in traps, made nearly in the form of a fourth figure, which are suspended on the trees, and baited with a piece of dried fish.

It was formerly remarked, that there are black squirrels in America. M. Aubry, curate of Saint Louis, has in his cabinet, a squirrel sent him from Martinico, which is totally black. It is also distinguished from other squirrels by having no hair, or at least a very small quantity, on its ears.

M. de la Borde, king's physician at Cayenne, remarks, that in Guiana, there is only one species of squirrel, which lives in the woods; that its hair is reddish; that it exceeds not the size of an European rat; that it feeds on the grain of the *Maripa*, *Aoura*, *Comana*, &c.; that it brings forth its young, to the number of two, in the holes of trees; that it bites like a rat; that it is easily tamed; that it makes a kind of low whistling cry; and that it is always seen alone, leaping from branch to branch.

I am not certain that this animal, mentioned by M de la Borde, is a real squirrel; for these animals in general are not found in very warm climates, such as that of Guiana. The species, on the contrary, is very numerous in the cold and temperate regions of both Continents.

'We find,' says M. Kalm, 'several species of squirrels 'in Pensylvania, where the small kind, called the 'ground squirrel, is preferred; because, though difficult 'to tame, it is most handsome. The large squirrels do 'much mischief to the plantations of maize. They cut 'the stems, in order to eat the pith. They sometimes 'come in hundreds into a field, and often devour the 'whole wheat in a single night. In order to destroy 'them, a price is put upon their heads. The inhabi-'tants eat the flesh of the squirrels, but put little 'value on their skins. The gray squirrels are common 'in Pensylvania, and in several other parts of North 'America. In figure they resemble those of Sweden; 'but both in summer and winter, they preserve their 'gray colour, and are likewise somewhat larger. They 'build their nests with moss and straw in the hollows of 'trees. They feed upon the fruits of the woods, but 'prefer the maize. They lay up provisions for winter, 'and remain in their magazines during the great colds. 'These animals not only do much injury to the maize, 'but likewise to the oaks, the flowers of which they de-'vour, so that the trees produce few acorns. . . . . It 'is alledged, that they are now more numerous in Pen-'sylvania than formerly, and that they have multiplied 'in proportion to the increase of the plantations of 'maize, which is their principal food.'

THE RAT.

THE rat has two cutting teeth in each jaw, four toes before, five behind, and a slender taper tail, naked or very slightly haired. It is of a deep iron gray colour, nearly black; the belly is cineritious, and the legs dusky

and almost naked. There is a claw, in place of a fifth toe, on the fore-feet. Its length is seven inches, and that of the tail near eight.

Nature, by descending gradually from great to small, from strong to weak, counterbalances every part of her works. Attentive solely to the preservation of each species, she creates a profusion of individuals, and supports by numbers the small and the feeble, whom she hath left unprovided with arms or with courage. She has not only put those inferior animals in a condition to perpetuate and resist by their own numbers, but she seems, at the same time, to have afforded a supply to each by multiplying the neighbouring species. The rat, the mouse, the field mouse, the water rat, the short tailed field mouse, the fat squirrel, the garden squirrel, the dormouse, the shrew-mouse, and several others, which I mention not, because they do not belong to our climate, form so many distinct and separate species, but so analogous to each other, that if any one should happen to fail, the gap in the genus would hardly be perceptible. It is this great number of neighbouring species which hath given to naturalists the idea of genera; an idea which can only be employed when we view objects in general, but which vanishes whenever we consider Nature in detail.

Men at first gave distinct names to objects which appeared to differ from each other; and at the same time, they gave general denominations to objects that seemed to be nearly similar. Among a rude people, and in the infancy of all languages, there is hardly any thing but general terms, or vague and ill-formed expressions for objects of the same order, though very different from each other. An oak, a beech, a linden tree, a fir, a pine, a yew, would at first have no other name but that of a *tree;* afterwards the oak, the beech, and the yew, would all be called *oak;* when these were distinguished from the fir, the pine, and the yew, the three latter would be called *fir*. Particular names could only be invented in consequence of a minute examination of each different species; and the numbers of these names are augmented in proportion to the extent of our knowledge of Nature: the more we examine her, proper and particular names will become more frequent. When natural objects therefore are represented to us under general denominations, or by classes and genera, it is recalling the darkness peculiar to the infant state of human knowledge. Ignorance is the parent of genera; but science will for ever continue to create and to multiply proper names; and I shall never hesitate in adding to their number, as often as I have occasion to delineate different species.

Several species of small animals have been confounded under the generic name of *Rat;* but we shall confine this name solely to the common rat, which is of a blackish colour, and infests the habitations of men. The rat commonly frequents granaries and barns, and from thence, when food is scarce, comes into our houses. He is a carnivorous, or rather an omnivorous animal: he seems only to prefer hard substances to those which are tender or succulent. He gnaws linen, cloths, furniture, makes holes in the walls, lodges in the ceilings, and in the void spaces between the wall and the wainscotting. From these lurking places the rats issue in quest of food, and transport thither every substance they can drag, forming considerable magazines, especially when they have young to provide for. The female brings forth several times a-year, but always in the summer season. The litter generally consists of five or six. They are fond of warmth, and in winter, insinuate themselves near the chimneys, or lodge among hay or straw: in spite of cats, poison, and snares, these animals multiply so greatly, that they often do much damage. In old country-houses where grain is kept, and where the vicinity of barns and magazines of hay facilitates their retreat, they often increase so prodigiously, that the possessors are obliged to remove and desert their habitations, unless the rats happen to destroy each other. It is well known, that rats, when pinched for food, eat one another. When a famine is created by too great a number being crowded into one place, the strong kill the weak, open their heads, and first eat the brain, and then the rest of the body. Next day the war is renewed, and continues in the same manner till most of them are destroyed. This is the reason why these animals, after being extremely troublesome, disappear all of a sudden, and return not for a long time. The same thing happens to field-mice, whose prodigious multiplication is interrupted only by the hostilities they exercise on each other when provisions become scarce. This sudden destruction is ascribed by Aristotle to the operation of rains. But rats are not exposed to rain, and the field-mice know how to guard themselves against its effects; for the holes they inhabit are not even moist.

The rats are as lascivious as they are voracious: they squeak during their amours, and cry when they fight. They prepare a bed for their young and soon learn them to eat. When the young begin to issue from their hole, the mother watches, defends, and even fights with the cats, in order to save them. A large rat is more mischievous, and nearly as strong as a young cat. The fore-teeth of the rat are long and strong: the cat is not a good biter; and as she uses her claws only, she requires to be both vigorous and accustomed to fight. The weasel, though smaller, is a more dangerous and formidable enemy, because he follows the rat into his hole. Their strength being nearly equal, the combat often continues long: but the method of using their arms is very different. The rat wounds only by reiterated strokes with his fore-teeth, which are rather destined for gnawing than biting; and being situated at the extremity of the lever or jaw, they have not much force. But the weasel bites cruelly

with the whole jaw, and instead of quitting his hold he sucks the blood from the wounded part; and therefore the rat uniformly falls a sacrifice to the weasel.

Of this species, as in all those which consist of numerous individuals, there are many varieties. Beside the common rat, which is blackish, some are brown, others gray, reddish, and even totally white. The white rats have red eyes, like the white rabbit, the white mouse, and all the other animals which are perfectly white. The whole species and its varieties appear to be natives of the temperate climates, and are more diffused over the warm than the cold regions. There were no rats originally in America; but those imported from Europe multiplied so prodigiously, that they were long the scourge of the colonies, where they had no enemies but large serpents which swallowed the rats alive. They have been carried by ships into the East Indies and all the islands of the Indian Archipelago; and are found likewise in Africa. But towards the north they have never multiplied beyond Sweden; for what are called Norwegian and Lapland rats are animals of a different species.

SUPPLEMENT.

Pontoppidan remarks, 'that neither the wood nor water 'rats can live farther north than Norway; that there are 'several districts, as that of Hordenver in the diocese of 'Bergen, and others in the diocese of Aggerhum, where 'no rats are to be found; and that the rats on the south 'banks of the river Vormen soon perish when carried to 'the north side of it. This difference,' he adds, 'can 'only be ascribed to certain exhalations of the soil, 'which are destructive to these animals.' These facts may be true: but we have often discovered that Pontoppidan is an author who deserves not entire credit.

M. le Vicomte de Querhoent has favoured me with the following remarks: that the rats, transported from Europe to the Isle of France, increased to such a degree, that it is alledged they made the Dutch leave the island. The French have diminished the number, though great quantities of them still remain. Some time, adds M. de Querhoent, after a rat resides in India, he acquires so strong a smell of musk, that he scents every thing for a considerable space round his habitation; and it is alledged, that when he comes near wine he makes it turn sour. This Indian rat appears to be the same which the Portuguese call *Cheroso*, or odoriferous rat. La Boullaye-le-Gouz says, 'that it is very small, 'and nearly of the figure of the ferret; that its bite is 'venomous; that its smell is immediately perceived 'when it enters a chamber; and that it cries *kric*, *kric*, '*kric*.'

This rat is likewise found in Madura, where it is called the *scented rat*. It is mentioned by the Dutch voyagers, who tell us, that its skin is as fine as that of the mole, but not so black.

THE MOUSE.

AN animal that needs no description; when found white, it is very beautiful, the full bright eye appearing to great advantage amidst the snowy fur.

The mouse is much smaller, equally numerous, and more generally diffused than the rat. It has the same instinct, the same constitution and natural dispositions, and differs only by its weakness and the habits which result from this circumstance. Timid by nature, and familiar from necessity, fear and want are the sources of all his movements. He never issues from his hole but in quest of food, and runs in again upon the smallest alarm. He goes not, like the rat, from house to house, unless he be forced; and he is not near so destructive. His manners are gentle, and he may be tamed to a certain degree; but he never discovers the smallest attachment to his benefactors. It is not indeed easy to love those who are perpetually laying snares for us. Though weak, the mouse has many enemies, from whom he has no means of escape but those of agility and minuteness. Owls, birds of prey, cats, weasels, and even rats, make war upon the mice. They are shot, caught in traps, and destroyed by millions. In a word, they subsist by their amazing fecundity alone.

They bring forth at all seasons, and several times in the year. The litter generally consists of five or six. In less than fifteen days the young are strong enough to disperse and to procure food for themselves. The duration of life in those small animals must therefore be short, since their growth is so rapid; and this circumstance still farther augments the idea of their prodigious multiplication. Aristotle tells us, that having shut up a pregnant mouse in a vessel, along with plenty of grain, he in a short time after found 120 mice all sprung from the same mother.

These little animals are by no means ugly; they have a vivacious and elegant air. That species of horror which some people feel at them arises from the surprise and inconveniences they sometimes occasion. All mice are whitish under the belly, and some are altogether white. Others are more or less brown and black. The

species is generally diffused over Europe, Asia, and Africa; and it is alledged, that those of America, where they are very numerous, came originally from the Old Continent. It is however certain, that this little animal follows man, and flies from uninhabited places, probably on account of its natural appetite for bread, cheese, butter, oil, and other aliments which men prepare for themselves.

SUPPLEMENT.

White mice with red eyes are found not only in our temperate climates, but in the southern and northern regions of both Continents. 'White mice with red eyes,' says Pontoppidan, 'have been found in the small village 'of Rams-dallem; but whether they are indigenous, 'or brought from the East-Indies, is uncertain.' This last supposition seems to have no foundation; for it is natural to expect white mice in Norway as well as every where else in Europe; and mice in general are equally numerous in America as in the Old Continent.

THE LONG-TAILED FIELD-MOUSE.

THIS animal has full black eyes; its head, back, and sides are of a yellowish brown, mixed with some dusky hairs; the breast is of an ochre colour; and the belly is white: its length, from the tip of the nose to the tail, is four inches and a half, and that of the tail, which is slightly covered with hair, is four inches.

This animal is less than the rat, and larger than the mouse. It never lives in houses, but is found in the fields and woods. Its eyes are remarkably large and prominent; and it differs still more from the rat and mouse, by the colour of its hair, which is whitish under the belly, and of a reddish brown on the back. It is very generally and copiously diffused, especially in elevated countries. It seems to take a considerable time in arriving at full growth, because it varies greatly in size. The largest are between four and five inches long; and the smaller ones, which appear likewise to be adults, are an inch shorter. And as we find them of all intermediate sizes, both the great and small are unquestionably the same species. Ignorance of this fact has probably led some naturalists to make two species of them, the one called *the great field-rat*, and the other *the field-mouse*. Ray, who first fell into this blunder, seems to acknowledge that he knew but one species. And though the short descriptions he has given of each species appear to differ, we ought not to conclude that both exist: 1. Because he himself knew but one. 2. Because, after all the researches I have made, I have not been able to discover more than one kind; because Gesner, and other naturalists, mention one species only, under the name of *mus agrestis major*, which they say is very common; and because Ray says that the other kind, called *mus domesticus medius*, is also very common: hence, it is apparent, that none of these authors have ever seen both kinds, since they acknowledge both to be very common. 3. Because in this single species individuals are found of a larger and lesser size, this circumstance might lead them to consider the small as of one species, and the larger of another. Lastly, because the descriptions are too vague and inaccurate to establish a specific difference.

The ancients indeed mention two species, the one under the denomination of *mus agrestis major*, the other under that of *mus agrestis minor*. These two species are very common, and we know them as well as the ancients: the first is our long-tailed field-mouse: the second is not the *mus domesticus medius* of Ray, but another animal, known by the name of the *short-tailed field-mouse*, or *little field rat*. And as it differs both from the rat and the long-tailed field-mouse, I have given it its Italian name, *compagnoli* or *compagnol*.

The long tailed field mouse, as I formerly remarked, lives in dry and elevated grounds. In the woods and adjacent fields they are found in vast numbers. They retire into holes among the brushwood and under the trunks of trees, where they amass great quantities of acorns, nuts, and beech-mast; sometimes a whole bushel is found in a single hole; and this hoard is not proportioned to the wants of the animal, but to the capacity of the place where it is deposited. These holes are generally more than a foot under ground, and often divided into two apartments, the one for living in along with their young, and the other for a magazine. I have frequently seen great damage done to the plantations by these animals. They carry off the new sown acorns; by following the furrow of the plough, they dig up one after another, not leaving a single seed. This happens chiefly in those seasons when the acorns are scarce: not finding enough in the woods, they come in quest of them in the cultivated fields, and do not eat them on the spot, but transport them to their holes, where they amass such quantities, that they often corrupt. These creatures alone do more mischief in a nursery of trees than all the birds and other animals put together. The only way to prevent this damage is, to lay traps at ten

paces asunder through the extent of the sown ground. No other apparatus is necessary than a roasted walnut placed under a flat stone, supported by a stick. The animals come to eat the walnut, which they prefer to acorns; and as the walnut is fixed to the stick, whenever they touch it, the stone falls and crushes them to death. I have used the same expedient for the destruction of the short-tailed field-mouse, which likewise destroys acorns. When I began this operation, I desired all the mice that were caught by the traps to be brought to me, and found, with astonishment, that above 100 were taken each day, from a piece of ground consisting only of about 40 French arpents. From the 15th of November to the 8th of December, above 2000 were slain in this manner. Their numbers gradually decreased till the frost became severe, when they retire to their holes, and feed upon the magazines they have collected. It is more than 20 years since I made this trial, which I always repeated when I sowed tree-seeds, and never failed to catch vast quantities of these mice. They abound chiefly in autumn; their numbers being much less in the spring: for if provisions fail during the winter, the strong devour the weak. The long-tailed field mice likewise eat the short-tailed species, and even thrushes, blackbirds, and other birds which they find entangled in snares. They first eat the brain, and then the rest of the body. I once kept a dozen of these mice in a cage, and furnished them with food every morning at eight o'clock. One day they were neglected for about a quarter of an hour, when one of their number was eaten up by the rest; next day another suffered the same fate; and in a few days, one only remained: all the others had been killed, and partly devoured; and even the survivor himself had his feet and tail mutilated.

The rat is very prolific; but the long-tailed field-mouse is more so. The latter brings forth more than once a-year, and the litters often consist of nine or ten, while those of the rat never exceed five or six. In one hole I have found two mothers and twenty young. This animal is very generally diffused over Europe. It is found in Sweden, and is called by Linnæus *mus cauda longa, corpore nigro flavescente, abdomine albo.* It is very common in France, Italy, and Switzerland: Gesner calls it *mus agrestis major.* The species is also numerous in Germany and in Britain, where it is called the *field-mouse.* It has for enemies, wolves, foxes, weasels, birds of prey, and its own species.

THE WATER-RAT.

RAT with a thick blunt nose; ears hid in the fur; eyes small; teeth yellow: on each foot five toes; inner toe of the fore foot very small; the first joint very flexible: head and body covered with long hairs, black mixed with a few ferruginous hairs; belly of an iron gray; tail covered with short black hairs, the tip whitish: weight nine ounces; length, from nose to tail, 7 inches; tail only 5.

This animal is about the size of a rat; but from its manners and dispositions, has a much greater resemblance to the otter than to the common rat. Like the otter, it frequents the fresh water, and is found in the margins of rivers, brooks, and pools, and lives mostly on fishes. Gudgeons, minnows, blays, and the fry of carps, pikes, and barbels, are his ordinary food. He likewise eats frogs, water insects, and sometimes the roots of plants. He has not, like the otter, membranes between his toes. This error has been copied from Willoughby by Ray and other naturalists. Though all his toes be separate, he swims with ease, keeps long under the water, and carries off his prey to be devoured upon the grass, or in his hole. He is sometimes surprised by fishers when searching for craw-fish; and he endeavours to escape by biting their fingers, or leaping into the water. His head is shorter, his muzzle thicker, his hair more bushy, and his tail much shorter, than those of the rat. Like the otter, he avoids large rivers, or rather those which are much frequented. He never visits houses or barns, but keeps upon the margins of waters, from which he wanders not upon dry land so far as the otter, which is sometimes found at the distance of a league from water. Water-rats are seldom met with in elevated places, or in dry plains, but are extremely numerous in moist and marshy valleys. The females come in season about the end of winter, and bring forth in the month of April, the litter generally consisting of six or seven. Perhaps they bring forth more than once a year; but of this we have no proper knowledge. Their flesh is not intolerably bad, being eaten by the peasants, as well as that of the otter, during the season of Lent. They are found every where over Europe, except in the polar regions. If we may credit Bellon, they inhabit the banks of the Nile; however, the figure he gives of them has so little resemblance to our water-rat, that it is probable the Nile rats form a different species of animals.

THE SHORT-TAILED FIELD-MOUSE.

THIS animal has a large head, a blunt nose, short ears hid in the fur, prominent eyes, and a short tail: the colour of the head and upper part of the body is ferruginous, mixed with black, and the belly is of a deep ash-colour. The length of the body, from tail to nose, 6 inches, and that of the tail, which is thinly covered with hair, and terminated by a small tuft, one inch and a half.

The short-tailed field-mouse is still more common and more generally diffused than the long-tailed kind. The latter never appears in high grounds; but the former is found every where, in the woods, the fields, the meadows, and even in the gardens. It is remarkable for the thickness of its head, and the shortness of its tail, which exceeds not an inch in length. It digs holes in the earth, where it amasses grain, filberts, and acorns: but it appears to prefer corn to every other food. In the month of July, when the grain is ripe, the short-tailed field-mice assemble from all quarters, and often do great damage by cutting the stalks of the corn, in order to come at the ears. They follow the reapers, and eat up all the fallen or neglected grain. When the gleanings are devoured, they flock to the new sown fields, and prematurely destroy the crop of the ensuing year. In winter, most of them retire into the woods, where they feed upon filberts, acorns, and the seeds of trees. In particular years, they appear in numbers so immense, that they would destroy every thing if they continued long: but they always kill and eat one another during a scarcity of provisions. They besides become the prey of the long-tailed field-mouse, the fox, the wild cat, and the weasels.

In its internal structure, this animal resembles the water-rat more than any other; but differs from him externally by several essential characters: 1. by the size; the short-tailed field-mouse is not above three inches long; but the water rat is seven inches: 2. by the dimensions of the head and body, those of the former being proportionally thicker than those of the latter: 3. by the length of the tail, which, in this field-mouse, exceeds not a third of the length of the animal's body; but the length of the tail of the water-rat is near two thirds of its body: lastly, by its manners and dispositions: it feeds not upon fishes, nor goes into water, but nourishes itself with acorns, grain, and tuberous roots, such as those of the dandelion, &c. Their holes resemble those of the long-tailed field-mouse, and are often divided into two apartments; but they are neither so spacious nor so deep. Several of them frequently live together. When the females are about to bring forth, they make beds of herbs for their young. They produce in spring and summer, and the litter generally consists of five or six, and sometimes of seven or eight.

THE GUINEA-PIG.

THE *restless cavy* has two cutting teeth in each jaw; generally four toes on the fore feet, and three behind, short ears, and no tail, or a very short one: the upper lip is half divided; the ears are very large, broad, and rounded at the sides: the hair is erect, and not unlike that of a young pig: the colour is white, or white variegated with orange and black, in irregular blotches.

This little animal, though a native of Brasil and of Guinea, lives and propagates in the temperate, and even in the cold climates, when protected from the inclemency of the seasons. Though Guinea-pigs multiply prodigiously in France, their numbers are never great; because the care they require is not compensated by the profits arising from them. Their skin is hardly of any value, and their flesh, though eatable, is not so good as to be much demanded; but it might be improved, by keeping them in warrens, where they would have the benefit of fresh air, and the liberty of choosing herbs agreeable to their taste. Those kept in houses have nearly the same bad taste with warren rabbits; and those kept in gardens during summer have an insipid, but less disagreeable savour.

The temperament of these animals is so hot and premature, that they copulate five or six weeks after their birth. They acquire not, however, their full growth before the 8th or 9th month. But this increase of size consists only of fat; for the solid parts are fully unfolded before the age of six months. The females go with young only three weeks; and I have known them bring forth at the age of two months. The first litter consists of four or five; the second of five or six; and the succeeding ones of seven or eight, and sometimes of

ten or twelve. The mother suckles her young twelve or fifteen days; she banishes them as soon as she receives the male, which happens at farthest three weeks after her delivery; and if any of them persist in following her they are maltreated and slain by the father. Thus these animals produce at least every two months; and as their young bring forth in the same space, we are astonished at their rapid and numerous multiplication. From a single couple we have 1000 in one year. But their destruction is as rapid as their propagation. They are killed by cold and by moisture; they allow themselves without resistance to be eaten by the cats; even the mothers defend not their young from their destroyers; not having time to form an attachment to their young, they make no efforts to save them. The males are still less solicitous about their offspring, and even allow themselves to be devoured without resistance. They seem to have no distinct sentiment but that of love. When under the influence of this passion, they are susceptible of anger, fight cruelly, and even kill each other in disputing the possession of a female. They pass their lives in sleeping, eating, and amours. Their sleep is short but frequent; they eat every hour, both day and night; and they indulge in mutual embraces as often as they eat. Though perpetually throwing out urine they never drink. They feed on all kinds of herbs, but especially on parsley, which they prefer to grain or to bread. They are likewise fond of apples and other fruits. They eat precipitately, like the rabbit, little at a time but very often. They make a kind of grunting noise similar to that of a young pig. A kind of chirping noise marks the time of their amours, and they raise a sharp cry when they feel pain. They are extremely delicate, and so impatient of cold, that it is difficult to preserve them through the winter. They must be kept in a dry, warm, wholesome place. When they feel cold, they assemble and crowd close together; and they often all perish in this situation. By nature they are gentle and tame. They do no mischief; but they are equally incapable of good; for they never form any attachments. Mild by constitution, docile through weakness, almost insensible to every object, they have the appearance of living machines constructed for the purposes of propagation, and of representing a species.

THE HEDGE-HOG.

THIS animal has five toes on each foot; and its body is covered with short spines; its nose is long; the nostrils are bordered on each side with a loose flap; the ears rounded, broad, and naked; the eyes small; the legs short, naked, and dusky; the inner toe is shortest, and the claws are weak; the upper part of the face, the sides and rump, are covered with strong coarse hair of a yellowish and cinereous colour; the back with strong short spines of a whitish colour, with a bar of black through their middle: the tail is an inch long; and the length of the body, from tail to nose, is ten inches.

'That the fox knows many things, and the hedge-'hog but one important thing,' is a proverbial saying of the ancients. The hedge-hog knows how to defend himself without fighting, and to wound without making an attack. Having little strength, and less agility for flight, he has received from nature a spinous armour, with the faculty of rolling himself up like a ball, and of presenting on all sides those sharp weapons which repel the enemy. The more he is harassed, he rolls himself up the closer. His fears tend still farther to defend him; for by throwing out his urine, the smell and humidity of which spreads over his whole body, he completely disgusts the enemy. Thus most dogs content themselves with barking, and never choose to seize the hedge-hog. The fox however accomplishes his end by wounding the animal's feet, and making the blood run into its mouth. But the hedge-hog is proof against the weasel, the martin, the polecat, the ferret, and birds of prey. From the head to the tail, both male and female are equally covered with spines, and the under parts of their bodies only are garnished with hair. But those arms which are so useful to them in defending against enemies become exceedingly inconvenient when they want to unite. They cannot copulate in the manner of other quadrupeds, but face to face, either on end, or lying. The females come in season in the spring, and bring forth in the beginning of summer. I have frequently had the mother and her young brought to me in the month of June. The litter generally consists of three or four, and sometimes of five. When very young they are white, and the buds of the spines only are visible through the skin. I tried to rear some of them, by putting the mother and her young in a barrel with plenty of provisions: but instead of suckling, she devoured them one after another. This was not the effect of hunger; for she eat bread, meat, and fruits. One would never have imagined that an animal so slow and indolent could be so impatient of confinement. It even possesses the same species of malevolence with that of

the monkey. A hedge-hog that had slipped into the kitchen took the meat out of a small kettle and defiled it with his ordure. I kept males and females in a room together; but though they lived, they never coupled. I left several of them in my gardens, where they did so little mischief that it could hardly be perceived. They live upon fallen fruits; and dig the earth to a small depth with their noses. They eat may-bugs, beetles, grasshoppers, worms, and some roots. They are likewise fond of flesh-meat, which they devour either raw or roasted. In the country they are frequently found in the woods, under the trunks of old trees, in the cliffs of rocks, and particularly among the stones collected upon the fields and vineyards. I am uncertain whether they climb trees, as some naturalists assert, or use their spines for transporting fruits or grapes. They seize with the mouth every thing they eat; and though they abound in our forests, they have never been discovered upon trees, but are always found in holes or under the moss. They stir not during the day, but go about the whole night. They approach not the habitations of men; but though they sometimes appear in the meadows, they prefer dry and elevated grounds. They are taken by the hand, never fly, nor defend themselves with their feet or their teeth; but when touched they roll up in the form of a ball, and will not extend themselves unless they be plunged in water. They sleep during the winter; and therefore the provisions they are said to amass in summer would be entirely useless to them. They eat little, and can live long without food. Their blood is as cold as that of those other animals who sleep during winter. Their flesh makes not good eating; and their skin, of which no use is now made, was formerly employed for heckling hemp.

Some authors mention two species of hedge-hog, one with a snout like a hog, and the other with a muzzle resembling that of a dog. But I know one species only, of which there are no even varieties in our climates. The hedge-hogs are very generally diffused: they are found everywhere in Europe, except in the cold regions of Norway, Lapland, &c. There are hedge-hogs, says Flacourt, in Madagascar, and they are called *Sora*. The hedge-hog mentioned by Tachard seems to be another animal; and the hedge-hogs of America and of Siberia are the species which approach nearest to that of the common kind. Lastly, the hedge-hog of Malacca seems to come nearer the porcupine than the hedge-hog.

THE SHREW MOUSE.

THE shrew mouse has two cutting teeth in each jaw, pointing forward, a long slender nose, small rounded ears, and five toes on each foot. The eyes are small, and almost hid in the fur; the nose is long and slender, the upper part being longest; the head and upper part of the body are of a brownish red colour, and the belly of a dirty white. The length of the body, from tail to nose, two inches and a half, and that of the tail one inch and a half.

The shrew mouse seems to form a link in the chain of small animals, and to fill the interval between the rat and the mole, which, though they resemble each other in size, differ greatly in figure, and are very distant species. The shrew is still smaller than the mouse, and has an affinity to the mole by its long nose; by its eyes, which, though larger than those of the mole, are much concealed, and more minute than those of the mouse; by the number of its toes, having five on each foot; by the tail and legs, especially the hind legs, which are shorter than those of the mouse; by the ears; and lastly, by the teeth. This little animal has a strong and peculiar odour which is very disagreeable to the cats, who pursue and kill, but never eat the shrews. It is probably this bad smell, and the reluctance of the cats, which have given rise to the vulgar prejudice that the bite of the shrew mouse is venomous, and particularly hurtful to horses. But the shrew is neither venomous, nor is it capable of biting; for the aperture of its mouth is not large enough to take in a duplicature of another animal's skin, which is absolutely necessary to the action of biting. The disease of horses, vulgarly ascribed to the bite of the shrew-mouse, is a swelling or blotch, and proceeds from an internal cause which has no relation to a bite. This animal, especially in winter, frequents hay-lofts, stables, barns, and dung-hills. It feeds upon grain, insects, and putrid flesh. In the country it frequents the woods and lives upon grain. It conceals itself under moss and the leaves and trunks of trees, and sometimes in the holes abandoned by the mole, or in smaller holes which it digs with its muzzle and claws. The shrew produces an equal number of young, though not so frequently as the mouse. Its cry is also much sharper; but it is not nearly so agile. It is easily taken; because it both sees and runs badly. The colour of the shrew is a mixture of brown and red; but some are ash-coloured, and others nearly black, though

all of them are white under the belly. They are very common in Europe; but they seem not to exist in America. The Brasilian animal mentioned by Macrgrave, under the name of the shrew mouse, which, he says, has two black lists on the back, is larger, and seems to be a different species.

THE WATER SHREW, OR BLIND MOUSE.

This animal has a long slender nose, very minute ears, and very small eyes, hid in the fur: the colour of the head and upper part of the body is black; and of the throat, breast, and belly, a light ash-colour: beneath the tail is a triangular spot. It is much larger than the common shrew, being from nose to tail, three and three-fourth inches long; and the length of the tail is two inches.

The water shrew, though a native of this climate, was unknown to any naturalist till M. Daubenton discovered, and gave an exact description of it. This animal is taken near the sources of fountains, at the rising and setting of the sun. During the day, it lies concealed in clefts of rock, or in holes upon the banks of rivulets. It brings forth in the spring, and the litter generally consists of nine.

THE MOLE.

THE mole has a long nose and snout; the upper jaw much longer than the under, no external ears, fore feet very broad, with scarce any apparent legs before, and hind feet very small. It has very minute eyes, hid in the fur, six cutting teeth in the upper, eight in the lower jaw, and two canine in each. The fore part of the body is thick and muscular, and the hind part taper; the fore feet are placed obliquely, and resemble hands, with five toes, each terminated by strong claws. The hind feet are very small, with five toes to each. The tail is short, and the skin very tough, so as scarce to be cut through. The hair, which is short, close set, and softer than the finest velvet, is usually black, sometimes spotted with white, and sometimes quite white. The length of the body is five and three-fourth inches, and that of the tail one.

The mole, though not blind, has eyes so small, and so covered, that it can have little benefit from the sense of seeing. Nature, by way of recompence, has bestowed on it a profuse portion of the sixth sense, remarkable vessels and reservoirs, a prodigious quantity of seminal fluid, enormous testicles, a penis of immoderate length; and all these parts are concealed within the body, which must render them more hot and active. Of all animals the mole is most amply endowed with generative organs, and consequently with their relative sensations. It has besides, a delicate sense of touch; a skin as soft as velvet; a very fine ear, and small hands, with five fingers, very different from the extremities of other quadrupeds, and nearly similar to the human hand; great strength in proportion to the size of its body; a compact skin; and a perpetual vigour. So lively and reciprocal an attachment subsists between the male and female, that they seem to dread or to disrelish all other society. They enjoy the placid habits of repose and of solitude, the art of securing themselves from disquiet and injury, of instantaneously making an asylum or habitation, of extending its dimensions, and of finding a plentiful subsistence, without the necessity of going abroad. These are the manners, the dispositions, and the talents of the mole; and they are unquestionably preferable to talents more brilliant and more incompatible with happiness, than the most profound obscurity.

The mole shuts up the entrance of her retreat, and seldom leaves it, unless compelled by the admission of water, or when its mansion is demolished by art. She makes a round vault in the meadows, and generally a long trench in the gardens; because it is easier to remove cultivated ground, than a turf rendered compact and solid by the roots of herbs. She continues not long in miry nor in hard stony ground, but delights in a soft earth, stored with esculent roots, and well peopled with insects and worms, which constitute her chief nourishment.

As the moles seldom leave their subterranean abodes, they have few enemies, and easily elude the carnivorous animals. The overflowing of rivers is their greatest scourge: during inundations, they are seen swimming in vast numbers, and using every effort to gain the more elevated grounds; but most of them perish, as well as their young, who remain in their holes. Without this devastation, the great talents they have for multiplying would render them extremely incommodious to man. They couple about the end of winter, and go but a short time with young; for we find them very small in the month of May. They generally bring forth four or five

at a time; and it is easy to distinguish the hillocks under which they litter; for they are larger, and made with more art than the common kind. I believe these animals bring forth more than once a-year; but of this I cannot be certain: it is a fact, however, that we meet with young ones from April to August. Perhaps some of them may be later in coupling than others.

The habitation where they deposit their young merits a particular description; because it is constructed with singular intelligence. They begin with raising the earth, and forming a pretty high arch. They leave partitions, or a kind of pillars at certain distances, beat and press the earth, interweave it with the roots of plants, and render it so hard and solid, that the water cannot penetrate the vault, on account of its convexity and firmness. They then elevate a little hillock below, upon the top of which they lay herbs and leaves, for a bed to their young. In this situation, they are above the level of the ground, and consequently out of the reach of ordinary inundations, and are at the same time defended from the rains by the large vault that covers the internal one, upon the convexity of which they rest, along with their young. This internal hillock, or vault, is pierced on all sides with sloping holes, which descend still lower, and serve as subterraneous passages for the mother to go in quest of food for herself and her offspring. These by-paths are firm and beaten, extend about twelve or fifteen paces, and issue from the mansion like rays from a centre. We likewise find, under the superior vault, the remains of the roots of the *colchicum*, or meadow saffron, which seem to be the first food given to the young. From this description it is apparent, that the mole never comes out but at a considerable distance from her habitation, and that the most simple and most certain method of taking both the old and the young, is to make a round trench, which will cut off all the communicating passages. But as the mole upon the smallest noise flies, and endeavours to carry off her young, it will be necessary to employ three or four men with spades to raise the hillock at once, or to make a trench almost instantaneously, and then to seize them, or to watch them as they attempt to escape.

It has been foolishly asserted by some writers, that the mole and badger sleep during the whole winter, without taking any food. The badger, as we formerly remarked, comes out of his hole in winter, as well as in summer, in quest of provisions; and it is easy to be ascertained of this fact, by the tracks he leaves upon the snow. The mole sleeps so little in winter, that she raises the earth in the same manner as she does in summer; and the country people remark, that *a thaw approaches, because the moles make hills.* They are, indeed, fond of warm places; and they are often caught by the gardeners in the months of December, January, and February.

The mole frequents cultivated countries only. There are none in the dry deserts, nor in the cold climates, where the earth is frozen during the greatest part of the year. The animal called the Siberian mole, with green and yellow hair, is a different species from our mole, which abounds only from Sweden to Barbary; for from the silence of travellers, it is presumeable that they exist not in hot climates. Those of America are likewise different: the Virginian mole, however, has a great resemblance to ours, except in the colour of the hair, which is mixed with a deep purple. But the red mole of America is a different animal. There are only two or three varieties in our common moles; we find them more or less brown or black; and we have seen them entirely white. Seba describes and gives a figure of a black and white mole, which was found in East Friesland, and was somewhat larger than our mole.

The mole of the Cape of Good Hope pretty much resembles the common species in the form of its body, in the eyes, in the ears, and in the tail; but it differs in the head, which is larger, and in the muzzle, which resembles that of a Guinea-pig. The fore feet are likewise different: the hair is not black, but dark brown, with a little yellow at the extremity of each hair. The tail is covered with large hairs of a yellowish white colour; and in general the hair of this mole is longer than that of the European. From all these descriptions we may conclude that it is a particular species, and that though allied to the common mole, it cannot be regarded as a simple variety.

THE PENSYLVANIAN MOLE.

In Pensylvania, says M. Kalm, there is a species of mole, which lives principally on roots. This animal digs in the fields small winding subterraneous alleys. In proportion to its size, it has more strength and rigidity in its paws than most other quadrupeds. In digging the earth, it uses its feet like oars. M. Kalm put one of them into his handkerchief; and he found that in less than a minute, it had made a number of small holes, as if the cloth had been pierced with a bodkin. It was very mischievous; and whenever it found any objects in its way, it immediately perforated them with its teeth. I presented to it, continues M. Kalm, my ink-piece, which was made of steel; it began to bite the ink-piece; but was soon repelled by the hardness of the metal, and never afterwards inclined to bite any thing that was held out to it. This animal raises not the earth, like the moles of Europe, but only makes small paths under the ground.

These characters are not sufficient to give us a proper knowledge of the animal, nor enable us to decide whether it belongs to the mole tribe.

THE BAT.

THIS animal has long extended toes to the fore feet connected by thin broad membranes, extending to the hind legs. The common bat has short ears, mouse-coloured fur, tinged with red: its length is two inches and a half, and the extent of the wings nine inches.

Though all beings are equally perfect in themselves, since they proceed from the hands of the same Creator; yet in relation to man some beings are more accomplished, and others seem to be imperfect or deformed. Of the former kind are all those whose figures appear to us to be agreeable and complete; because all their parts and members are proportioned, all their movements and functions are easy and natural. The latter kind of beings, which to us have a hideous aspect, comprehends all those whose qualities are noxious to man, whose nature is uncommon, and whose form differs from the ordinary figures from which we received our primary sensations, and derived those ideas which serve as models to our judgment. The head of a man upon the neck of a horse, and its body covered with feathers, and terminating in the tail of a fish, represents a picture of enormous deformity, for no other reason but because it unites what nature has placed at the greatest distance. An animal like the bat, which is half a quadruped and half a bird, and which upon the whole is neither the one nor the other, must be a monstrous being; because, by uniting the attributes of two opposite genera, it resembles none of those models presented to us in the great classes of nature. It is an imperfect quadruped, and a still more imperfect bird. A quadruped should have four feet, and a bat should have feathers and wings. In the bat, the fore feet, though they serve the animal for the double purpose of flying and of trailing its body on the ground, are neither wings nor feet. They are deformed extremities, the bones of which are enormously lengthened, and united by a membrane, which is neither covered with feathers nor with hair. They are a species of pinions or winged paws, in which we see only a claw of an inch in length; and the other four long toes must act along with the former; for they have no proper movements or separate functions. They are a kind of hands ten times larger than the feet, and four times longer than the body of the animal. In fine they are parts which have rather the air of caprice than of a regular production. This membrane covers the arm, forms the wings or hands of the animal, unites with the skin of the body, and at the same time surrounds the legs, and even the tail, which by this whimsical conjunction becomes in some measure one of its toes. To these dissimilarities and disproportions of the body and its members may be added the deformities of the head, which are often much greater: for in some species the nose is hardly visible, the eyes are sunk near the ear, and confounded with the cheeks: in others the ears are as long as the body, or the face is twisted into the form of a horse-shoe, and the nose turned up like a cock's comb. All of them have small, obscure, covered eyes, a nose, or rather nostrils, ill-formed, and a mouth extending from ear to ear: they all likewise endeavour to conceal themselves, fly the light, inhabit dark places only, from which they never go out but during the night; they return at break of day, and fasten themselves against the walls. Their motion in the air is rather a desultory fluttering than flying, which they execute very awkwardly. With difficulty they raise themselves from the earth, and never fly to any great height: they quicken, relax, or direct their flight in a manner the most bungling and imperfect. Their flight is neither rapid nor direct, but consists of quick vibrations in an oblique and winding direction. They fail not, however, in passing to seize flies, gnats, and particularly moths, which fly during the night only. These they swallow almost entire; and we find in their excrements portions of wings and other dry and indigestible parts of moths. Having one day descended into the caverns of Arcy to examine the stalactites, I was surprised to find, in a place covered with alabaster, and so dark and profound, a kind of earth which was totally different: it was a thick mass, several feet in extent, of a blackish matter, almost entirely composed of fragments of the wings and legs of flies and moths, as if immense numbers of these insects had assembled in order to die and corrupt together. This however was nothing else but the dung of bats, probably amassed during many years in a favourite part of these subterranean caverns; for through the whole of these caverns, which extend above half a quarter of a league, I saw no other collection of this matter; and I imagined that the bats had fixed upon this place for their common abode; because it was reached by a glimmering light from an aperture in the rock, and that they chose not to go farther, lest they should be lost in a darkness too profound.

Bats are real quadrupeds: except the faculty of flying they have nothing in common with birds. But as the action of flying implies great strength in the upper and anterior parts of the body, the bats have their pectoral much stronger and more fleshy than those of quadrupeds; and in this they have an affinity to the birds. They differ from birds however in every other part of their structure, both external and internal: the lungs,

the heart, the organs of generation, and all the other viscera, are similar to those of quadrupeds, except the penis, which is pendulous and loose, a thing peculiar to man, the monkeys, and the bats. Like the quadrupeds the bats are viviparous, and have teeth and paps. It is said they bring forth but two at a time, and that they suckle their young, and even carry them when flying. In summer they copulate and bring forth; for they are in a torpid state during winter. Some cover themselves with their wings as with a mantle, and suspend themselves by the hind feet to the vaults of subterraneous caverns; others stick fast to old walls, or retire into holes. Wherever they take up their winter abode, they always assemble in such numbers as to secure them against the effects of cold. They pass the winter without food or motion, never awake till the spring, and again retire at the end of autumn. They support hunger better than cold: though carnivorous animals, they can subsist several days without food. When they get into a larder, they fix upon the suspended meat, and eat flesh whether raw or roasted, fresh or corrupted.

Two species of bats only have been described as natives of our climate. Beside these M. Daubenton has discovered other six, which are equally numerous and common. It is astonishing therefore that they should so long have escaped notice. These species are perfectly distinct, and never associate together.

The first, which is well known, is the common bat, of which we have already given the synonimes.

The second or long-eared is likewise known to the naturalist, and is perhaps still more numerous than the common bat. The long-eared bat is much less than the common species; its wings are likewise shorter, and its muzzle smaller and sharper, and its ears of an immoderate size.

The third species, which we shall denominate the *noctule*, from the Italian word *notula*, was not known, though very common in France, and even more frequent than the two preceding species. This bat is found under the eaves of houses, castles, and churches, and also in the hollows of old trees. It is nearly as large as the common bat. Its ears are broad and short, its hair reddish, and it has a sharp piercing voice, like the sound of a small bell.

The fourth species we shall call the *Serotine*. It is smaller than the common bat or noctule, and nearly of an equal size with the long-eared bat. But it differs from the latter in having short, pointed ears, blacker wings, and the hair of a deeper brown.

The fifth species we shall call *Pipistrelle*, from the Italian word *pipistrello*, which likewise signifies a bat. The pipistrelle is not near so large as the common bat, the serotine, the noctule, or even the long-eared kind. It is the smallest and least ugly of all the bats, though the upper lip is turgid, the eyes small and deep sunk, and the front much covered with hair.

The sixth species I call *Barbastelle*, from the Italian word *barbastello*, which also signifies a bat. This animal is nearly of the same size with the long-eared species: its ears are as broad, but not near so long. The name *barbastelle* is the better adapted to it, because it appears to have large whiskers: this however is only an appearance occasioned by the turgidness of the cheeks, which form a kind of pudding above the lips. The muzzle is very short, the nose much flattened, and the eyes near the ears.

Lastly, we shall call the seventh species the *horse-shoe*. The countenance of this animal is remarkably deformed. The most striking feature is a membrane in the shape of a horse-shoe, which surrounds the nose and the upper lip. In France it is very common, and frequents the walls and vaults of old houses. Some of them are larger, and others smaller; but they are otherwise so similar in form that we consider them as of the same species. But as I have remarked this difference, without finding any of an intermediate size, I cannot determine whether it is an effect of different ages, or a constant variety in the same species.

THE FAT SQUIRREL.

SQUIRREL with thin naked ears; body covered with soft ash-coloured hair; belly whitish; tail full of long hair; from nose to tail near six inches; tail four and a half; thicker in the body than the squirrel.

We have three species of this animal, the fat squirrel, the garden squirrel, and the dormouse, which like the marmot sleep during the winter. Of these the fat squirrel is the largest, and the dormouse the least. Several authors have confounded these three species, though they are easily distinguishable. The fat squirrel is about the size of the common squirrel, and has its tail covered with long hair: the garden squirrel is not so large as a rat, has very short hair on its tail, except near the extremity, where it is bushy: the dormouse is not larger than the common mouse; the hair on its tail is longer than that of the garden squirrel, but shorter than that

of the fat squirrel, and its tip is bushy. The garden squirrel differs from the other two, by having black spots near its eyes, and the dormouse by having whitish hair upon its back. All the three are white or whitish on the throat and belly; but the garden squirrel is of a fine white, the fat squirrel only whitish, and the dormouse rather yellowish than white, in all the under parts of the body.

These animals are improperly said to sleep during winter; for it is not a state of natural sleep, but a torpor or numbness of the senses and members, produced by a chilliness of the blood. The internal heat of these creatures exceeds not that of the air. When the heat of the air is ten degrees above the freezing point, their temperature is precisely the same. I have plunged the ball of a thermometer into the bodies of several living garden squirrels, and found their internal heat to be always nearly equal to the temperature of the air: I have even seen the thermometer sink a degree or half a degree when applied to the heart, the temperature of the air being at that time only 11 degrees. Now we know that the heat of man, and of most quadrupeds, is always more than 30 degrees. It is not therefore surprising that these animals whose heat is so small, should fall into a benumbed state, whenever their internal heat is not augmented by that of the external air; and this always happens when the thermometer exceeds not ten or eleven degrees above the freezing point. This is the true cause of the torpid state of what are called the sleeping animals; a cause which, though common to all animals that sleep during winter, has hitherto been overlooked. I have discovered it in the three animals under consideration, in the hedge-hogs, and in the bats; and though I have never had an opportunity of examining the marmot, I am persuaded that its blood, like that of the other sleepers, is cold; because it is subject to torpor during the winter.

This torpid state continues as long as the cause by which it is produced, and ceases with the cold. A few degrees of heat above ten or eleven is sufficient to reanimate them; and if kept in a warm place during the winter, they are never benumbed, but go about, and eat and sleep from time to time, like other animals. When they feel cold, they roll themselves up in the form of a ball, in order to expose less surface to the air, and to preserve their natural warmth. It is in this form that they are found during the winter, in hollow trees, and in holes of walls exposed to the south. There they lie, without the smallest motion, upon moss and leaves; and though tossed about, they neither extend themselves, nor exhibit any signs of life. From this state nothing can rouse them but the application of a gentle and gradual heat; for they die when suddenly brought near a fire. Though in this state they have no motion, though their eyes are shut, and they seem to be deprived of every sensation; yet they feel pain when it is acute. A wound or a burn, makes them contract, and utter a low cry which they even repeat several times: hence their internal sensibility, as well as the action of the heart and lungs, still subsist. It is presumeable, however, that these vital motions act not with equal force as when the animal is in its ordinary state. The circulation, it is probable, proceeds in the large vessels only; the respiration is slow and feeble; the secretions are inconsiderable; and no excrements are voided. There must likewise be little or no perspiration, since they pass several months without eating, which could not happen, if they lost as much of their substance by perspiration as they do at other times, when they have an opportunity of repairing this natural waste by taking nourishment. They still, however, lose some part; because in long winters, they die in their holes. Perhaps, likewise, it is not the duration, but the rigour of the cold that destroys them; for they soon die when exposed to a strong frost. What induces me to think that they perish not by loss of substance, is, that in autumn they are exceedingly fat, and equally so when they revive in the spring. This quantity of fat serves for an internal nourishment to the animal, and supplies what it loses by respiration.

As cold is the only cause of their torpor, and as they fall not into this state but when the temperature of the air is below ten or eleven degrees, they frequently revive during the winter; for in this season, there are often many days when the liquor in the thermometer stands at 12, 13, 14, and even higher degrees; and during fine weather of this kind, the dormice come out of their holes in quest of food, or eat what they had collected in autumn. Aristotle, and all the succeeding naturalists, have asserted, that the dormice pass the whole winter without eating; that in this season of abstinence they grow very fat, and that they are better nourished by sleep alone, than other animals by food. This notion is both absurd and impossible. The dormouse, which sleeps four or five months, could only fatten by the air it respires. Supposing a part of this air to be converted into nourishment, an augmentation so considerable could never be the result. It would not even be sufficient to repair the continual waste occasioned by perspiration. Aristotle might be led into this error by the mild winters of Greece, where the dormice sleep not perpetually, but often revive, take plenty of food, and are therefore extremely fat, though in a torpid state. The truth is, they are fat at all times, and particularly in summer and autumn. Their flesh resembles that of the Guinea-pig. The Romans reckoned dormice among their most delicate dishes, and reared them in great quantities. Varro describes the method of making warrens for them; and we learn from Appicius the manner of dressing them in the high taste of his times. In this practice, whether from a disgust at these animals,

because they resemble rats, or from the badness of their flesh, the Romans have not been followed by other nations. I have been informed by peasants who had eat them, that they were not better than water-rats. Besides, the fat squirrel is the only species that is eatable; the flesh of the garden squirrel is bad, and has a disagreeable flavour.

In manners and dispositions, the fat squirrel greatly resembles the common species. It lives in forests, climbs trees, and leaps from branch to branch, with less agility indeed, because the squirrel has longer legs, and a body more light and meagre. They both, however, live upon the same food, namely, filberts, chesnuts, and wild fruits. The fat squirrel likewise eats small birds, which he takes in their nests. He makes not a nest in the tops of trees, like the squirrel; but he makes a bed of moss in the hollows of their trunks, or in the cliffs of rocks; but he always chooses a dry place. He abhors moisture, drinks little, and seldom descends on the ground. He differs still more from the squirrel in this circumstance, that the latter is easily tamed, and the former continues always wild. They couple in the end of spring, and the females bring forth in summer, the litter generally consisting of four or five. The young grow quickly; and we are assured that they live six years only. In Italy, where these animals are still eat, the natives dig pits in the woods, and strew them with straw, moss, and beach-mast. They choose dry places, under the shelter of rocks, and with a south exposure. To these the fat squirrels resort in great numbers, and the people find them there in a torpid state towards the end of autumn, when they are in the best condition for eating. These small animals are bold, and defend their young to the last extremity. They bite violently with their fore-teeth, which are very long, and of great strength. They neither fear the weasel nor small birds of prey. They escape from the fox, because he cannot follow them to the tops of trees. Their most formidable enemies are the martins and wild cats.

The fat squirrels are not generally diffused. They appear not in very cold climates, such as those of Lapland and Sweden; at least they are not mentioned by the northern naturalists: the species they describe is the dormouse, which is the least of the three. Neither I imagine are they to be met with in very warm countries, because our travellers are silent on this article. There are few or none in open countries, like Britain; they require temperate climates abounding with wood. We find them in Spain, in France, in Greece, in Italy, in Germany, and in Switzerland, where they live in the forests upon the hills, and not on the tops of high mountains, like the marmots, which, though subject to torpor from cold, seem to delight in frost and snows.

GARDEN SQUIRREL, GREATER DORMOUSE, or SLEEPER.

THE squirrel, with the eyes surrounded with a large spot of black, reaching to the base of the ears, and another behind the ears; head and whole body of a tawny colour; the throat and whole underside of the body white, tinged with yellow; the tail long; the hairs at the beginning very short, at the end bushy; length, from nose to tail, not five inches; the tail four.

The fat squirrel dwells in forests, and seems to avoid the habitations of men. The garden squirrel, on the contrary, lives in gardens, and is sometimes found in our houses. The species is likewise more numerous, and more generally diffused: there are few gardens which are not infested with them. They nestle in holes of the walls, run upon the trees and espaliers, single out the best fruits, and devour them when they begin to be mature. They seem to prefer peaches, which, if we be desirous of preserving, we should be careful to destroy the garden squirrels. They also climb with ease pear, apricot, and plumb-trees; and when soft fruits are not to be had, they eat almonds, filberts, nuts, and even leguminous plants. Of these they carry off great quantities into their retreats which they dig in the earth, and particularly in well cultivated gardens; for in old orchards, they are often found in the hollows of trees, where they make beds of herbs, moss, and leaves. Cold benumbs or makes them sleep, and they are revived by heat. Eight or ten of them are frequently found in the same place, all benumbed, and rolled up, in the midst of their provision of nuts and filberts. They copulate in spring, and bring forth in summer. The litter consists of five or six young, which grow very quickly; but which nevertheless are not fertile till the following year. Their flesh is not eatable, like that of the fat squirrel: they have the same disagreeable odour with the domestic rat; but the fat squirrel has no bad smell. They never become so fat, and want those fat follicles with which the intestines of the former are entirely invested. The garden squirrel is found in all the temperate climates of Europe, and even in Poland and Prussia; but he appears not to exist in Sweden and the more northerly regions.

THE DORMOUSE, OR SLEEPER.

THE squirrel with round naked ears; full black eyes; body of a tawny red; throat white; size of a mouse, but plumper; tail two inches and a half long, and pretty hairy, especially towards the end.

The dormouse is the least ugly of all the rats. It has brilliant eyes and a bushy tail, which is rather fair than red. It never lives in houses, and seldom in gardens; but like the fat squirrel frequents the woods, and dwells in the hollows of old trees. The species is by no means so numerous as that of the garden squirrel. The dormouse is always found alone in its hole; and there is a considerable difficulty in procuring specimens of them. It appears however that they are pretty frequent in Italy, and that they exist in northern climates; for Linnæus mentions them in his list of Swedish animals. But they seem not to inhabit Britain; for Mr. Ray, who had seen them in Italy, says, that the *little sleeping rat* of England is not red on the back like that of Italy, and that perhaps it is a different species. In France it is the same as in Italy, and is very well described by Aldrovandus. But he tells us there are two species in Italy; the one is rare, and has the smell of musk; the other is common, and has no particular odour; and that at Bologna they are both called dormice, because of their resemblance in figure and size. We know only the second of these species; for our dormouse has no smell, either good or bad. Like the garden squirrel it wants the fat follicles which invest the intestines of the fat squirrel, never becomes so fat, and though its flesh has no disagreeable odour it makes not good eating.

Like the fat and garden squirrels the dormouse rolls itself up and sleeps in winter, revives in mild weather, and amasses nuts and dry fruits. It makes its nest upon trees, like the common squirrel, but generally lower, between the branches of hazel or brushwood. The nest, which consists of interwoven herbs, is about six inches diameter, and is open above only. I have been assured by many countrymen, that they have found these nests in cut woods and in hedges; that they are surrounded with moss and leaves; and that in each nest there were three or four young. When they grow large they abandon the nests, and harbour in the hollows or under the trunks of old trees, where they repose, amass provisions, and sleep during the winter.

THE BROWN RAT.

RAT with the head, back, and sides of a light brown colour, mixed with tawny and ash-colour; breast and belly dirty white; feet naked, and of a dirty flesh-colour; fore feet furnished with four toes, and a claw instead of the fifth; length from nose to tail nine inches; tail the same; weight eleven ounces; is stronger made than the common or black rat.

To this species of rat, which has been known for a few years past only, I have given the appellation of *Surmulot*. This animal is mentioned by no naturalist except M. Brisson, who calls it the *wood-rat*. It is larger and more mischievous than the common rat. It has reddish hair, a very long naked tail, and the spine of the back arched like that of the squirrel. Its body is likewise thicker; and it has whiskers like a cat. It is not above nine or ten years since this species was diffused through the environs of Paris. From whence these animals came is uncertain; but they have multiplied prodigiously. Neither is this wonderful, when we consider that they generally produce from 12 to 15 young at a litter, and sometimes even 19. They were first discovered at Chantilly, Marly-la-Ville, and Versailles, where they committed great ravages. M. le Roy favoured me with great numbers of them, both living and dead, and communicated to me the remarks he had made upon this new species. The males are larger, stronger, and more mischievous than the females. When hard pursued, or when we attempt to seize them, they face about and bite the stick or the hand that strikes them. Their bite is not only cruel but dangerous; for it is instantly followed by a considerable swelling, and the wound, though small, does not soon heal. The females bring forth three times a year; hence two individuals of this species may produce at least 36 young in 12 months. The mothers prepare a bed for their offspring. Some of the females sent us, which we kept in cages, were with young; and two or three days before they brought forth, we observed that they gnawed the wood of the cages, and made of the cuttings, which were in considerable quantities, a convenient bed for their little ones.

The brown rats have some qualities which make them approach to the nature of the water-rat. Though every

where diffused they seem to prefer the banks of waters. The dogs pursue them with the same remarkable fury as they chase the water-rat. When pursued, and they find it equally easy to take to the water, or to conceal themselves in brushwood, they choose the water, enter it without fear, and swim with great dexterity and ease. This phænomenon is chiefly exhibited when they cannot regain their holes; for like the long-tailed field-mouse, they dig subterraneous retreats, or rather they nestle in those made by the rabbits. The brown rats may be taken in their holes by ferrets, which pursue them with equal ardour as they do the rabbit.

These animals pass the summer in the country: and though they feed principally upon fruits and grain, they eat young hares, partridges, and fowls: when they enter a hen-house, like the polecat, they kill more than they can eat. Towards the month of November, the mother and all the young quit the fields, and come in troops into the barns, where they do infinite mischief by mincing the straw, consuming the grain, and infecting every thing with their ordure. The old males remain in the fields, each inhabiting his own hole, where, like the field-mice, they amass acorns, beech-mast, &c. filling the holes to the top, and remaining themselves at the bottom. They sleep not like the dormouse; but go out in winter, especially when the weather is mild. Those which take up their abode in barns banish all the mice and rats. It has even been remarked, that since the multiplication of the brown rat about Paris the common rats are much less frequent.

THE ALPINE MARMOT.

MARMOT with short round ears, hid in the fur; cheeks large; colour of the head and upper part of the body brownish ash, mixed with tawny; legs and lower part of the body reddish; subject to vary in colour, the Polish marmot being much more red, and of a brighter hue; four toes before, five behind; tail pretty full of hair; length from nose to tail about sixteen inches, tail six; and body thick.

Of all modern naturalists Gesner has brought greatest advantages to the science. To great erudition he has joined good sense and enlarged views. Aldrovandus is only the commentator of Gesner, and authors of less note have implicitly copied him. We hesitate not therefore to borrow facts from him with regard to the marmots, which are natives of his country, and concerning which he was better informed than us, though like him we have kept several of them in a state of confinement. What he says corresponds so exactly with our own observations, that we doubt not the truth of his remarks when he retails facts of which we have no knowledge.

The marmot when taken young may be rendered nearly as tame as our domestic animals. He learns to seize a stick, to dance, to perform various gesticulations, and to obey the voice of his master. Like the cat he has an antipathy against dogs. When he begins to be familiar in the house, and perceives that he is protected by his master, he attacks and bites dogs of the most formidable kind. Though not so large as a hare he is stouter, and his strength is aided by a peculiar suppleness and dexterity. With his fore teeth, which are pretty long, he bites most cruelly. He attacks not however either dogs or men unless when he is irritated. If not prevented he gnaws furniture and stuffs, and when confined even pierces through wood. As his limbs are short, and his toes fashioned like those of the bear, he often sits on end, and walks with ease on his hind legs. He carries food to his mouth with the fore legs, and eats in the manner of a squirrel. He runs pretty quickly up hill, but slowly on a plain. He climbs trees, and mounts between the cliffs of rocks, or two adjoining walls; and the Savoyards, it is said, learned from the marmots to climb for the purpose of sweeping chimneys. They eat every thing presented to them, as flesh, bread, fruit, roots, pot-herbs, may-bugs, grass-hoppers, &c.; but milk and butter they prefer to every other aliment. Though less inclined to theft than the cat, they endeavour to slip into the dairy, where they drink great quantities of milk, making, like the cat, a purring noise expressive of pleasure. Besides, milk is the only liquor that is agreeable to them; for they rarely drink water; and they refuse wine.

As to figure the marmot has some resemblance both to the bear and to the rat. It is not, however, as Perrault and some others imagined, the *arctomys*, or *bear-rat* of the ancients. Its nose, lips, and form of the head, resemble those of the hare; it has the hair and claws of the badger, the teeth of the beaver, the whiskers of the cat, the eyes of the fat squirrel, and the legs of the bear. The tail is short, and the ears terminate abruptly. The hair on the back is of a reddish brown colour, more or less deep: this hair is pretty rude; but that of the belly is reddish, soft, and bushy. Its voice resembles the murmuring of a young dog when caressed or in a sporting humour. But when irritated or frighted, it makes a

whistling noise, so loud and piercing, that it hurts the ear. It loves cleanliness, and retires, like the cat, to void its ordure. But like the rat, it has a very strong disagreeable smell, especially in summer. It is remarkably fat in autumn: besides a large epiploon, it has two very thick fatty follicles. All the parts of its body, however, are not equally fat. The back and reins are loaded with firm and solid fat, similar to the flesh of a cow's udder. Thus the marmot would make very good eating, if it had not always a disagreeable odour, which cannot be concealed but by very strong seasonings.

This animal, which delights in the regions of frost and snow, and which is found only on the tops of the highest mountains, is more subject than any other to be rendered torpid by cold. In the end of September, or beginning of October, he retires into his hole, from which he comes not out till the beginning of April. His retreat is made with precaution, and furnished with art. It is capacious, broader than long, and very deep, so that it can contain several marmots, without any danger of corrupting the air. With their feet and claws, which are admirably adapted for the purpose, they dig the earth with amazing quickness, and throw it behind them. It is not a hole or a straight or winding tube, but a species of gallery made in the form of a Y, each branch of which has an aperture, and both terminate in one, where the animal lodges. As the whole is made on the declivity of a mountain, the innermost part alone is on a level. Both branches of the Y are inclined, and the one is used for depositing the excrements of the animals, and the other for their going out and coming in. The place of their abode is well lined with moss and hay, of which they make ample provision during the summer. It is even affirmed, that this labour is carried on jointly; that some cut the finest herbage, which is collected by others, and that they alternately serve as vehicles for transporting it to their dens. One, it is said, lies down on his back, allows himself to be loaded with hay, extends his limbs, and others trail him in this manner by the tail, taking care not to overset him. These repeated frictions are assigned as the reason why the hair is generally rubbed off from their backs. But it is more probable that this effect is produced by their frequent digging of the earth, which is sufficient to peel the hair off their backs. Whatever may be in this, it is certain that they dwell together, and work in common at their habitations, where they pass three-fourths of their lives. Thither they retire during rain, or upon the approach of danger, and never go out but in fine weather, and even then to no great distance. One stands sentinel upon a rock, while the others sport on the grass, or are employed in cutting it to make hay. When the sentinel perceives a man, an eagle, a dog, &c. he alarms the rest by a loud whistle, and is himself the last to enter the hole.

They make no provisions for winter, as if they divined that they would then have no use for victuals. But when they perceive the first approaches of the sleeping season, they shut up the two entrances of their habitation; and this they perform with such labour and solidity, that it is more easy to dig the earth any where else, than in the parts they have fortified. They are at this time very fat, weighing sometimes twenty pounds; and they continue to be plump for three months; but afterwards gradually decay, and are extremely emaciated at the end of winter. When discovered in their retreats, they are rolled up in the form of a ball, covered with hay; and they are carried off in so torpid a state, that they may be killed without seeming to feel pain. The fattest are chosen for eating, and the young ones for taming. Like the dormice, they are revived by a gradual heat; and those which are fed in houses, and kept warm, never become torpid, but are equally lively and active in winter as in summer. As to the sleeping of the marmot, we shall not repeat what was said under the article of the fat squirrel. The cooling of the blood is the sole cause of this phænomenon; and it has been remarked by other writers, that in this torpid condition, the circulation, as well as all the secretions, were extremely languid, and that the blood, not being renewed by fresh accessions of chyle, has no serosity. Whether they remain constantly torpid for seven or eight months, as is alledged by most authors, is uncertain. Their holes are deep, and they live together in numbers; a considerable heat therefore must be preserved for some time, and they may eat the herbage they have amassed. We are even told by M. Altmann, in his treatise on the animals of Switzerland, that the hunters allow the marmots to remain unmolested for three weeks or a month; that they never dig in soft weather, or during a warm wind; that without these precautions, the marmots awaken and dig still deeper; but that by opening their retreats during hard frosts only, they find them so torpid as to be carried off with ease. We may therefore conclude, that they in every respect resemble the dormice; and that if they remain longer torpid, it is because they inhabit a climate where the winter is longer.

These animals produce but once a year, and the litter generally consists of three or four. The growth of their young is very quick; they live only nine or ten years; and the species is neither numerous nor much diffused. The Greeks were unacquainted with the marmot, or at least they have made no mention of it. Among the Latins, Pliny is the first who takes notice of it, under the name of *mus Alpinus*, or Alpine rat: and indeed though there are several species of rats in the Alps, none of them is so remarkable as the marmot, or like it, lives in the summits of the highest mountains. The other species confine themselves to the valleys, the sides of the hills, or first mountains. Besides, the marmot never

descends from the heights, but seems peculiarly attached to the chain of the Alps, and to prefer a south or east exposure to that of the north or west. He is found, however, in the Appennines, the Pyrenees, and the highest mountains of Germany. The *bobak* of Poland, to which M. Brisson, and after him Messrs. Arnault de Nobleville et Salerne, have given the name of *marmot*, differs from this animal, not only in colour, but in the number of toes; for it has five toes on the fore-feet. The claw of the great toe appears beyond the skin: and we find within, the two phalanges of the fifth toe, which is entirely wanting in the marmot. Hence the *bobak*, or Polish marmot, the *mouax*, or marmot of Canada, the *cavia*, or marmot of Bahama, and the *cricet*, or marmot of Strasburgh, are all different species from the Alpine marmot.

THE MARMOT OF KAMTSCHATKA.

The Russian travellers have discovered an animal in Kamtschatka, which they have called a marmot, but of which they have given us a very slight intimation only. They tell us, that its skin resembles at a distance, the variegated plumage of a beautiful bird; that like the squirrel, it uses its fore-feet in eating; and that it feeds on roots, berries, and cedar-nuts. It is worthy of remark, that the expression *cedar-nuts* presents a false idea; for the true cedar bears cones, and other trees, called by the name of cedars bear berries.

The MARMOT of the CAPE OF GOOD HOPE.

We owe the first notices of this animal to M. Allamand, a learned naturalist and professor at Leyden. M. Pallas has described it under the name of *Cavia Capensis*, and M. Vosmaer under that of the *Bastard African Marmot*.

'This animal,' says M. Vosmaer, 'is known at the Cape of Good Hope, under the name of the *Rock Badger*, probably because it lives among rocks, and under the earth, like the badger; to which, however, it has no resemblance. It has a greater affinity to the marmot, and yet it differs considerably from that animal. . . . . Kolbe is the first who mentions this animal, and he says, that it resembles the marmot more than the badger.'

We shall adopt the name of the *Marmot of the Cape*, in preference to that of the cavia, because it differs from the cavia or cabiai in many respects: 1. In the climate, the cavia being an animal of South America, while the other is found in Africa only. 2. Because cavia is a Brasilian word, and ought not to be transported into Africa, since it belongs to the true cavia, and to the cavia-cobaia, or Guinea-pig. Lastly, because the cabiai inhabits only the margins of waters, and has membranes between its toes; but the marmot of the Cape lives among rocks, and in dry grounds, which it can dig with its claws.

'The first animal of this species,' says M. Vosmaer, 'that appeared in Europe, was sent by M. Tulbagh to the Prince of Orange, and its skin is still preserved in his cabinet. The colour of the first differed greatly from that of another which arrived afterwards: it was very young and very small. That which I am about to describe was a male, and was sent me by M. Bergmeyer of Amsterdam. . . . . The life of this animal, according to my information, is very melancholy; for it slept much during the voyage. Its motion is slow, and performed by leaps. But perhaps in a natural state, it is equally active as the rabbit. Its cries were frequent, but short, sharp, and piercing.'

I shall observe in passing, that this character brings the animal still closer to the marmot; for the Alpine marmots often make a sharp whistling noise.

'In Holland,' continues M. Vosmaer, 'they feed this marmot with bread and different kinds of pot-herbs. It is probable that this animal brings forth often, and in great numbers. The form of their feet indicates that they are destined for digging the earth. The present marmot having died at Amsterdam, I gave it for dissection to M. Pallas.

'In stature it resembles the common rabbit, but it is thicker and more collected. The belly is peculiarly gross; the eyes are beautiful, and of an ordinary size. The eye-brows, both above and below, are garnished with some short black hairs, above which there are five or six hairs of the same colour, but long, that turn back toward the head. It has similar whiskers on the upper lip, about the middle of the muzzle.

'The nose is blacks, naked, and divided by a fine suture, which descends to the lip. The nostrils resemble a cord broken through the middle. Under the muzzle, on the throat and cheeks, are some long, rude, black hairs; and hairs of the same kind are scattered over the whole body. In the palate there are eight deep furrows; the tongue is very thick, tolerably long, garnished with small papillæ, and oval at the point. In the upper jaw, there are two strong teeth, which protrude over the under jaw, and are considerably distant from each other, having a kind of triangular appearance. In the under jaw, it has four close cutting teeth, which are very broad, long, and flat. The grinders, of which it has four on each side, are also large; and a fifth of a smaller size may be added to the number. Its fore-legs are short, and half covered with the skin of the body. The feet are black and naked. Those before have four toes; the middle one is longest; and the exterior one is shorter, and seems to adhere to the third. The toes are armed with round short claws, which adhere to the skin like the human nails. There are three toes on the hind-

feet; the middle one only is furnished with a crooked claw, and the exterior toe is shorter than the others. The animal leaps on its hind legs, like the rabbit. It has not the smallest vestige of a tail. The colour of the hair is gray, or a yellowish brown, nearly like that of a wild rabbit; but it is deeper upon the head and back; and the breast and belly are whitish. There is also a whitish belt upon the neck and near the shoulders. This belt forms not a collar, but terminates at the top of the fore-legs. In general, the hair is soft and woolly.'

THE BEAR.

THE bear has six cutting teeth and two canine in each jaw; five toes before and five behind. In walking he rests on the hind feet as far as the heel.

There is no animal so generally known as the bear, concerning which the writers of natural history have differed so much. Their uncertainties, and even contradictions, with regard to the nature and manners of this animal, seem to have proceeded from their not distinguishing properly the different species; and of course they sometimes ascribe to one the properties of another. In the first place the land bear must be distinguished from the sea-bear, the latter being commonly called the *white bear*, or *bear of the frozen sea*. These two animals are very different, both in the form of their bodies and in their natural dispositions. The land bears must again be distinguished into the *brown* and the *black*; because having neither the same inclinations nor the same natural appetites, they cannot be regarded as varieties only of one and the same species. [Under the denomination of the brown bears I comprehend those which are brown, yellow, red, or reddish; and under black, all the shades of that colour.] Besides, some land bears are white, and though resembling in colour the sea bear, they differ from it in every other particular as much as the other bears. These white land bears are found in Great Tartary, in Muscovy, in Lithuania, and in other northern regions. They are not rendered white during winter by the rigour of the climate, like the ermines or the hares, but are brought forth white, and remain so in all seasons. They ought therefore to be considered as a fourth species, if we did not also find bears with their hair consisting of a mixture of brown and white, which indicates an intermediate race between the white land bear and the brown or black bear; consequently the white land bear is only a variety of one or other of these species.

The brown bear is very common in the Alps; but the black bear is extremely rare. The latter, on the contrary, abounds in the forests of the northern regions of Europe and America. The brown bear is furious and carnivorous; but the black bear is only wild, and uniformly refuses to eat flesh. Of this we cannot give a more distinct and recent testimony than that of M. du Pratz. [illegible]

'The black bear,' says he, 'appears in Louisiana during the winter; because the snows which cover the northern countries prevent him from finding sufficient nourishment. He lives upon fruits, acorns, and roots; but he is peculiarly fond of honey and milk; and when he meets with these articles he will rather die than quit them. Notwithstanding the common prejudice, I affirm, and in this assertion I am supported by all the inhabitants of this province, and of the neighbouring countries, that he is not a carnivorous animal. Though numerous, and often pressed by extreme hunger, they never devour men, nor eat even butcher-meat when they fall in with it. During the time I lived among the Natches, a severe winter in the northern regions made the bears descend in vast quantities. They were so numerous that they starved each other, and were very meagre. Famine made them come out of the woods which border on the river. We saw them during the night run into houses and court-yards which were not properly shut, where they found meat exposed; but they never touched it, and eat only what grains they could pick up. On an occasion so pressing they must have infallibly discovered their carnivorous disposition if they had an appetite of this nature. They never kill animals to devour them; and if they were carnivorous, they would not abandon countries covered with snow, where they could find men and animals at will, in order to search for fruits and roots, a species of food rejected by the carnivorous tribes.' M. du Pratz adds in a note, that since writing the above article he had learned with certainty that in the mountains of Savoy there are two kinds of bears, the one black, like those of Louisiana, and not carnivorous; the other red and equally carnivorous as the wolves. The Baron de Hontan remarks, that the bears of Canada are very black, but by no means dangerous; and that they never attack men unless when shot at and wounded. He farther observes, that the reddish bears are extremely mischievous, and boldly attack the hunters; but that the black bears uniformly fly from men.

Wormius informs us that there are three kinds of bears in Norway: the first (*bressdiur*) is very large, not altogether black, but brownish, and not so destructive as the other kinds, living only on herbs and the leaves

of trees: the second (*ildgiersduir*) is smaller, blacker, and carnivorous, often attacking horses and other animals, especially in autumn: the third (*myrebiorn*) is still smaller, but fails not to be noxious. He is said to feed upon ants, and delights in overturning their hillocks. It has been remarked, (he adds, without proof), that these three kinds mix, and produce intermediate species; that the carnivorous kind attacks the flocks, kills every creature, like the wolf, and devours only one or two; that though carnivorous they eat wild fruits; and when the fruit of the service-tree abounds, they become more dangerous, because this sour fruit sets their teeth so much on edge that nothing but blood or grease can remove this malady, which prevents them from eating with ease. But most of these facts related by Wormius appear to be extremely equivocal; for we have no examples of animals with appetites so uniformly different as those of the two first species, the one living on herbs and the leaves of trees, and the other on flesh and blood, intermixing and producing intermediate species. Besides, he makes the black bears carnivorous, and the brown frugiverous, which is absolutely repugnant to truth. Add to this, that P. Rzacynski, a Polish writer, and M. Klein, of Dantzick, in describing the bears of their country, mention two species only, the black, and the brown or red; and of the latter, they speak of a larger and lesser kind. They remark, that the black bears are more rare; that the brown, on the contrary, are very common; that the black bears are the largest, and feed upon ants; and lastly, that the red or brown kind are the most carnivorous and destructive. These proofs, added to those of M. du Pratz and of the Baron de la Hontan, are perfectly opposite to what Wormius advances. In a word, it appears to be certain, that the red or brown bears, which are found not only in Savoy but in the high mountains, in the vast forests, and in almost every desert of the earth, devour live animals, and even the most putrid carcasses. The black bears inhabit not very cold countries, but we find the brown or red bears in the frozen, the temperate, and even in the southern regions. They were common in Greece; and the Romans brought them from Lybia to be exhibited at their public spectacles. They are found in China, in Japan, in Arabia, in Egypt, and as far as the island of Java. Aristotle likewise mentions white land bears, and considers this difference of colour as accidental, and proceeding from a defect in generation. Thus bears are found in all desert, rude, and woody countries. But they never appear in populous nations, nor in open and cultivated regions. There are none in France or in Britain, except perhaps a few in the most unfrequented mountains of France.

The bear is not only a savage but a solitary animal. He flies from all society, avoiding every place to which man can have access, and is only easy where nature appears in her rudest and most ancient form. An old cavern among inaccessible rocks, or a grotto formed by time in the trunk of a decayed tree, in the midst of a thick forest, serve him for an habitation. Thither he retires alone, and passes part of the winter without provisions, and goes not out of it for several weeks. However, he is neither torpid, nor deprived of feeling, like the dormouse and marmot; but as he is excessively fat about the end of autumn, which is the time he retires, this abundance of grease enables him to endure abstinence; and he departs not from his den till he is almost famished. It is alledged that the males leave not their retreats for forty days; but that the females continue four months, because it is there that they bring forth their young. It is difficult to believe that they should not only subsist, but nourish their young, without taking food for so long a period. I allow, that when pregnant they are prodigiously fat, and that being clothed with a very thick hair, sleeping the greatest part of the time, and remaining without motion, they must lose little by perspiration. But if it be true that the males pressed with hunger go out in forty days, is it not natural to think, that the females, after bringing forth and suckling their young, should feel more the want of food, unless we suppose them to devour some of their own offspring, together with the membranes, &c. which is not probable, notwithstanding the example of the cats, which sometimes eat their young? Besides, I am here talking of the brown species only, the males of which devour the new born cubs when they discover them in their dens. The females, on the contrary, seem to love their offspring with an astonishing ardour: after they bring forth, they are more ferocious and more dangerous than the males. They fight and expose themselves to every peril in order to save their young, who are not unformed for some time after birth, as the ancients alledged, but grow nearly as quick as other animals. They are perfectly formed in the womb of the mother; and if the fœtus, or young cub, seems at the first glance to be ill-formed, it is only because the old bear herself, upon the whole, is an animal gross and disproportioned; and we know, that in every species the fœtus, or new born animal, is more disproportioned than the adult.

Autumn with the bears is the season of love: the female is said to be more ardent than the male. It is alledged that she lies on her back to receive him, that she embraces him closely, and keeps him fast for a long time, &c. It is certain, however, that they copulate like other quadrupeds. Captive bears have been seen coupling, and have been impregnated. But how long the females go with young has not been so accurately marked as could be wished. Aristotle has said, that they go with young 30 days only. As nobody has contradicted this fact, and as we are not in a condition to verify it, we of course can neither affirm nor deny

with regard to this matter. We shall only remark, that it appears to be doubtful: 1. Because the bear is a large animal; and in proportion to the size of animals, they require the longer time to be formed in the womb: 2. Because the young bears grow very slowly; they follow their mother, and require her assistance for a year or two: 3. Because the female produces but one, two, three, four, and never more than five; a property common to all large animals, who produce but a few young, and carry them long: 4. Because the bear lives 20 or 25 years, and the time of gestation and that of growth are generally proportioned to the duration of life. From these analogies, I am inclined to believe that the bear goes with young at least several months. However this matter stands, the mother takes the greatest care of her young. She prepares for them a bed of moss and herbs in the bottom of her cavern, and suckles them till they are able to go abroad with her. She brings forth in winter, and the cubs begin to follow her in the spring. The male and female live not together; but each has a separate and a distant retreat. When they cannot find a cavern for a den, to make a lodging, they break and collect branches of trees, which they so cover with herbs and leaves as to render them impenetrable by water.

The voice of the bear is a deep murmuring, often accompanied with a grinding of the teeth, especially when irritated. He is very susceptible of anger, which is always furious, and often capricious. Though when tamed, he appears mild and even obedient to his master, he should always be treated with diffidence and circumspection; and we should be particularly careful not to strike him on the nose, or on the parts of generation. He may be taught to walk on end, to dance, and to perfom various gesticulations. He seems even to listen to music, and to observe some kind of measure. But to give him this species of education, he must be taken young, and constrained during life. An old bear cannot be tamed, nor will he suffer restraint. He is naturally intrepid, or at least indifferent to danger. The wild bear never turns out of his road, nor flies from the aspect of man. It is alledged, however, that the sound of a whistle surprises and confounds him to such a degree, that he rises on his hind feet. This is the time for shooting, and endeavouring to kill him; for if he be only wounded, he attacks the huntsman with fury, embraces him with his fore-feet, and suffocates him if not timely assisted.

Bears are hunted in different manners. In Sweden, Norway, Poland, &c. the least dangerous mode, it is said, is to intoxicate them by throwing ardent spirits on honey, of which they are fond, and search for it in the trunks of trees. In Louisiana and Canada, where the black bears are common, and where they live not in caverns, but in decayed trees, they are taken by setting their habitations on fire. As they climb trees with ease, they seldom reside on a level with the ground, and their habitations are often 30 or 40 feet high. If it be a mother with her young, she descends first, and is slain before she reaches the ground. The cubs follow, are seized by throwing a rope round their necks, and carried off either for the purposes of training or eating them; for the flesh of the cubs is delicate and good: that of the adult is eatable; but as it is mixed with an oily fat, the paws alone, which are more compact, are reckoned a delicate dish.

The hunting of the bear, without being very dangerous, is extremely lucrative, when performed with success. The skin is a valuable fur, and the quantity of oil drawn from a single bear is considerable. The flesh and fat are boiled together in a caldron, and the oil is easily separated. 'Afterwards,' says M. du Pratz, 'the oil is purified, by throwing it when very warm, into a quantity of salt and water. A detonation ensues, and a thick smoke rises, which carries off the disagreeable odour of the grease. When the smoke ceases, and while the grease is still warm, it is put into a pot, where it is allowed to remain for eight or ten days. At the end of this period, a clear oil is seen swimming on the top, which is taken off with a ladle. This oil is equally good, and answers the same purposes as the best olive oil. Beneath, we find a lard as white, but a little softer than hog's-lard. It serves for culinary purposes, and has no bad taste or smell.' M. Dumont, in his Memoirs of Louisiana, agrees with M. du Pratz, and adds, that from a single bear, they obtain more than 120 pots of this oil; that the savages traffic in this article with the French; that it is very wholesome and good; that it never congeals but during great colds, and when this happens, it is all clotted and of a dazzling whiteness; and that then it is eaten upon bread, like butter. Our druggists keep no bear's grease, but import from Savoy, Switzerland, or Canada, axungium, which is by no means pure. The author of the Dictionary of Commerce affirms, that good bear's grease should be grayish, viscid, and of a disagreeable odour; and that when too white, it is sophisticated and mixed with suet. It is applied topically in hernias, rheumatism, &c. and many persons assure us, that they have felt its good effects.

The amazing fatness of the bear makes him light for swimming; and accordingly he traverses with ease, rivers and lakes. The bears of Louisiana,' says Dumont, 'which are of a fine black colour, cross the river, notwithstanding its great breadth. They are remarkably fond of the fruit of the *plaqueminier, guiacana*, or date plumb-tree: they climb these trees, sit astride upon a branch, keep themselves firm with one hand, and collect the fruit with the other. They frequently come from the woods into the cultivated fields to eat potatoes and yams.' In autumn, they are so fat, that they can hardly

walk, or at least, they cannot run so quick as a man. Upon the sides and thighs they have sometimes ten inches thick of fat. The soles of their feet are gross and inflated. When wounded, there issues out a white lacteous juice. This part appears to be composed of small glands, like *papillæ;* and it is for this reason, that these animals, during their winter retreat, continually suck their paws.

The bear enjoys, in an excellent degree, the senses of seeing, hearing, and touching, though his eye is proportionally small, his ears short, and his skin thick and covered with bushy hair. His sense of smelling is, perhaps, more exquisite than that of any other animal; for the internal surface of this organ is very much extended, having four rows of bony plates, separated from each other by three perpendicular planes, which increase prodigiously the surfaces proper for the reception of impressions from odoriferous bodies. He has fleshy legs and arms, like those of a man, a short heel-bone, which forms a part of the sole of the foot, five metatarsal bones opposed to the heel in the hind-feet, and an equal number of metacarpal bones in the fore-feet. But the thumb is not separated, and the largest finger is on the outside of this species of hand; whereas in man it is on the inside. His toes are thick, short, and locked to each other, both in the hands and feet. His nails are black, and of a hard homogeneous substance. But these gross resemblances to man render the bear only more deformed, and give him no superiority over the other animals.

SUPPLEMENT.

M. de Musly, major of artillery in the service of the States General, has communicated some notices concerning domestic bears, of which the following is an extract.

'At Berne, where these animals are nourished,' says M. de Musly, 'they are kept in large square ditches, where they have room to walk about. These ditches are covered above, and lined with stone, both at the bottom and on the sides. Their lodges or cabins are likewise paved on a level with the bottom of the ditch, divided into two by walls, and may be shut both internally and externally by iron gates. In the middle of these ditches, there are large holes in the pavement, where considerable trees may be set up on end. There is likewise in each ditch, a trough full of fresh water.

'Two young brown bears were transported here from Savoy, thirty-one years ago, of which the female is still alive; the male was killed about two months ago, by a fall from one of the high trees planted in the ditch. They began to generate at the age of five years: since that time, they have every year come in season during the month of June; and the female has always brought forth in the beginning of January. The first time she produced one cub only, and afterwards, sometimes one, sometimes two, and sometimes three, but never more; and the three last years she brought forth one only at each time. The man who takes care of her, thinks her still pregnant (October 17, 1771.) When the young come into the world, their figure is pretty; their colour is yellow, but white round the neck; and they have not the least appearance of bears. The mother is extremely fond of them. Their eyes are shut during four weeks. At first they exceed not eight inches in length; and three months after, they measure 14 or 15 inches from the end of the muzzle to the root of the tail; and their hair is nearly an inch long. Their figure is then almost round, and the muzzle is very sharp pointed; so that a person would hardly know them. They afterwards become weak and tender till they acquire their full growth; the white colour is gradually effaced, and the yellow changes into brown.

'During the act of copulation, the male commences with short, but brisk movements, which last about a quarter of a minute; he then reposes double that time upon the female, without disengaging himself: in this manner he proceeds for three or four times; and when the operation is finished, the male bathes himself in the trough up to the neck. They sometimes fight cruelly, making a horrible grumbling noise. But in the season of love, the female has generally the advantage, because the male at that time spares her. The ditches which formerly were in the town, are now filled up, and others are made between the ramparts and the old walls. These two bears, having been separated some hours when removing into the new ditches, raised themselves on end when they again met, and embraced each other with transport. After the death of the male, the female appeared to be much afflicted, and refused every kind of nourishment for several days. But unless these animals be brought up and fed together from their earliest youth, they cannot endure one another; and after being accustomed to this kind of society, the survivor will not admit another mate.

'The trees put yearly into the ditches in the month of May, are green larches, in climbing upon which the bears take vast delight. They are fed with rye-bread, which is cut into large morsels, and steeped in warm water. They likewise eat all sorts of fruits; and when any unripe fruits are brought to the market, they are thrown in to the bears by order of the magistrate.' It has been remarked, however, that some bears prefer pulse to the fruits of trees. When the female is about to bring forth, they give her plenty of straw, of which she makes a rampart. After this, the male is removed, lest he should eat the cubs; and when she has littered, she is fed with a more nourishing diet than usual. We never could perceive any part of the membranes or afterbirth, which makes it probable that she eat them. The

cubs are allowed to remain with her for ten weeks; and are afterwards separated and fed for some time with milk and biscuit.

'The bear which we believed to be in a state of pregnancy was furnished about the usual time with straw, of which she made a bed, and rested on it during three weeks without producing any thing. She brought forth, for the last time, at the age of 31, in the month of January, 1771; but though she received the male in the following June, it was ineffectual in January 1772. It were to be wished that she was allowed to live, in order to discover the term fixed by nature for the duration of these animals.

'There are brown bears on Mount Jura upon the frontiers of our canton, in Franche-compté, and in the country of Gex. When they descend into the plains in autumn, they repair to the chesnut woods, where they make great havock. In this country the bears are said to have weak eyes, but acute senses of hearing, touching, and smelling.'

The bears of Norway are more common in the provinces of Bergen and Drontheim than in the other districts of that country. Two races of them are remarked, of which the one is considerably smaller than the other. In the colours of both there are great varieties. Some of them are of a deep brown, others of a shining brown; and some are gray, and of every shade of white. At the beginning of October they retire into the dens they prepare for themselves, and where they make a kind of bed composed of moss and leaves of trees. As these animals are very formidable, especially when wounded, there are seldom less than three or four hunters in company; and as the bear easily kills large dogs, they employ only small dogs who pass under his belly, and seize him by the genitals. When he finds himself overpowered he leans his back against a rock or a tree, collects turf and stones which he throws at his enemies; and it is generally in this situation that he receives the finishing blow.

We have seen at the menagerie of Chantilly an American bear, of a fine black colour, and having soft straight long hair. We remarked other differences in the figure of this American bear, compared with that of Europe, as in the head, which is somewhat longer, because the muzzle is not so flat as that of the European bear.

In the relation of M. de Bertram's expedition, we have a notice of an American bear killed near St. John's river, in East Florida, in the following terms:

'This bear,' according to the relation, 'weighed only 400 pounds, though the length of its body was seven feet from the extremity of the nose to the tail. The fore feet were only five inches broad, and the thickness of the fat was four inches. We drew from this animal 60 Paris pints of oil.'

THE BEAVER.

THE beaver has two cutting teeth in each jaw, five toes on each foot, and a tail compressed, and covered with scales. He has strong cutting teeth, short ears hid in the fur, a blunt nose, hair of a deep chesnut brown, a broad, almost oval, tail, compressed horizontally, and with scales; the fore feet are small, and the hind feet large; the length, from nose to tail, is about three feet; and the tail is eleven inches long and three broad.

In proportion as man rises above a state of nature, the other animals sink below that standard: reduced to slavery, or treated as rebels and dispersed by force, their societies have vanished, their industry and genius have become barren, their arts have disappeared, each species has lost its general qualities, and the whole have preserved only their individual properties, matured in some by example, by imitation, and by instruction; and in others, by fear, and by the necessity of perpetually watching over their own safety. What views, what designs can be possessed by slaves without spirit, or exiles without power? Compelled to fly, and to exist in solitude, they can attain to no improvement; they can neither acquire nor transmit knowledge, but must continually languish in calamity and decay; they must perpetuate without multiplying; and in a word, they must lose by their duration more than they acquire by experience.

It is for this reason that there are now no remains of that astonishing industry of animals, except in those distant and desert regions where, for a long succession of ages, they have received no disturbance from man, where each species can display with freedom its natural talents, and mature them in quiet, by uniting into permanent societies. The beavers afford perhaps the only subsisting monument of the ancient intelligence of brutes, which, though infinitely inferior in principle to the human intellect, supposes common projects and relative views; projects which, having society for their basis, and for their object a dike to construct, a town to build, or a republic to found, imply some mode of

making themselves understood and the capacity of acting in concert.

The beavers are said to be among quadrupeds what the bees are among the insect tribes. There are in nature, as she now appears, three species of societies, which must be examined before we can compare them: the free society of man, from which, next to God, he derives all his power; the constrained society of the larger animals, which always flies before that of man; and the necessary society of certain small creatures, which being all produced at the same time, and in the same place, are obliged to live together. An individual, solitary as he comes from the hand of nature, is a sterile being, whose industry is limited to the simple use of his senses. Even man himself, in a state of pure nature, deprived of the light and assistance of society, neither multiplies nor constructs. Fertility, on the contrary, is the necessary result of every society, however blind or fortuitous, provided it be composed of creatures of the same nature. From the necessity alone of desiring to approach or to avoid each other, common movements arise, from which there often results a work that has the air of being concerted, managed, and executed with intelligence. Thus the works of bees, each of whom in a given place, such as a hive or the hollow of an old tree, builds a cell; the works of the Cayenne bee or fly, which not only makes the cells but the hive that is to contain them, are operations purely mechanical, and imply no intelligence, no concerted project, no general views; they are labours which, being the produce of a physical necessity, a result of common movements, are at all times, and in all places, uniformly executed in the same manner by a multitude not assembled from choice but united by the force of nature. Hence it is not society, but numbers alone, which operate here. It is a blind power, never to be compared to that light by which all society is directed. I speak not of that pure light, that ray of divinity, which has been imparted to man alone. Of this the beavers, as well as all the other animals, are most assuredly deprived. But their society, not being a union of constraint, but proceeding from a species of choice, and supposing at least a general concert and common views in its members, implies likewise a certain degree of intelligence, which, though different in principle from that of man, produces effects so similar as to admit of comparison, not indeed to the luminous society of polished nations, but to the rudiments of it, as they appear among savages, whose union and operations can alone, with propriety, be compared to those of certain animals.

Let us then examine the product of each of these associations; let us see how far the art of the beaver extends, and to what the talents of the savage is limited. To break a branch, and to make a staff of it, to build a hut, and to cover it with leaves for shelter, to collect hay or moss, and to make a bed of these materials, are operations common to the animal and to the savage. The beavers build huts, the monkeys carry staves, and several other animals make commodious and neat houses, which are impenetrable to water. To sharpen a stone by friction, and make a hatchet of it, to use this hatchet for cutting or peeling the bark off trees, for pointing arrows, for hollowing a vessel, or for slaying an animal in order to clothe themselves with its skin, to make bowstrings of its sinews, to fix the sinews to a hard thorn or bone, and to use these for needles and thread, are actions purely individual, which man in solitude may perform without the aid of others; actions which depend solely on conformation, because they suppose nothing but the use of the hand. But to cut and transport a large tree, to build a village, or to conduct a large canoe, are operations, on the contrary, which necessarily suppose common labour and concerted views. These works are the result of infant society in savage nations; but the operations of the beavers are the fruits of society already matured among these animals; for it must be remarked, that they never think of building but in countries where they are perfectly free and undisturbed. There are beavers in Languedoc and in the islands of the Rhone; and they abound in many of the northern provinces of Europe. But as all these countries are inhabited, or at least frequented by men, the beavers there, like all the other animals, are dispersed, solitary, fugitive, and timid creatures. They have never been known to unite, or to construct any common work. But in desert regions, where men in society were long of arriving, and where some vestiges only of savages could be traced, the beavers have every where united, formed associations, and constructed works which continue to excite admiration. Of this I shall endeavour to quote the most judicious and irreproachable authorities, and shall hold as certain only those facts concerning which authors agree. Less inclined perhaps than some of them to indulge admiration, I shall venture to doubt, and even to criticise, every article that appears too hard to be credited.

It is universally allowed, that the beaver, in his purely individual qualities, instead of possessing any marked superiority over the other animals, appears on the contrary to sink considerably below some of them: and I am enabled to confirm this fact, being possessed of a young beaver sent me from Canada, which I have kept alive near twelve months. This animal is very gentle, peaceable, and familiar. It is somewhat melancholy, and even plaintive; but has no violence or vehemence in its passions. Its movements are slow, and its efforts feeble; yet it is seriously occupied with a desire of liberty, gnawing from time to time the gates of its prison, but without fury or precipitation, and with the sole view of making an opening for its escape. In other matters it seems to be extremely indifferent, forming no attachments, and neither wishes to hurt nor to please,

[We are told, however, by M. Klein, that he fed a beaver during several years, and that it followed, and went in quest of him, as dogs search for their masters.] In these relative qualities, which would make him approach to man, he seems to be inferior to the dog. He appears to be formed neither for serving, commanding, nor even holding commerce with any other species than his own. His sense, locked up in his own person, never entirely manifests itself but among his own tribe. When alone he has little personal industry, less artifice, and hardly prudence enough to avoid the grossest snares. Instead of attacking other animals, he is very aukward in defending himself. He prefers flight to combat, though he bites cruelly when he finds himself seized by the hand of the hunter.

If then we consider this animal in a state of nature, or rather in a state of solitude and dispersion, he appears not, by his internal qualities, to rise above the other animals. He has not the genius of a dog, the sense of an elephant, the craftiness of the fox, &c. but is more remarkable for some singularities of external conformation, than for any apparent superiority of mental faculties. He is the only quadruped furnished with a flat, oval tail, covered with scales, which he uses as a rudder to direct his course in the water; the only animal that has his hind feet webbed, and the toes of his fore feet, which he employs for carrying victuals to his mouth, separate from each other; the only quadruped that resembles the land animals in the anterior parts of his body, and the aquatic animals in the posterior. He forms the link between quadrupeds and fishes, as the bat does between quadrupeds and birds. But these peculiarities would be rather defects than perfections, if the beaver knew not how to derive, from this singular conformation, advantages which render him superior to every other quadruped.

The beavers begin to assemble in the month of June or July, for the purpose of uniting into society. They arrive in numbers, from all corners, and soon form a troop of two or three hundred. The place of rendezvous is generally the situation fixed for their establishment, and is always on the banks of waters. If the waters be flat, and never rise above their ordinary level, as in lakes, the beavers make no bank or dam. But in rivers or brooks, where the waters are subject to risings and fallings, they build a bank, and by this artifice, they form a pond or piece of water which remains always at the same height. The bank traverses the river, from one side to the other, like a sluice, and it is often from 80 to 100 feet long, by 10 or 12 broad at the base. This pile, for animals of a size so small, appears to be enormous, and supposes an incredible labour. But the solidity with which the work is constructed, is still more astonishing than its magnitude. The part of the river where they erect this bank is generally shallow. If they find on the margin a large tree, which can be made to fall into the water, they begin with cutting it down, to form the principal part of their work. This tree is often thicker than the body of a man. By gnawing the foot of the tree with their four cutting teeth, they accomplish their purpose in a very short time, and always make the tree fall across the river. They next cut the branches from the trunk, to make it lie level. These operations are performed by the whole community. Several beavers are employed in gnawing the foot of the tree, and others in lopping off the branches after it has fallen. Others, at the same time, traverse the banks of the river, and cut down smaller trees, from the size of a man's leg to that of his thigh. These they dress, and cut to a certain length, to make stakes of them, and first drag them by land to the margin of the river, and then by water to the place where the building is carrying on. These piles they sink down, and interweave the branches with the larger stakes. This operation implies the surmounting of many difficulties; for to dress these stakes, and to put them in a situation nearly perpendicular, some of the beavers must elevate with their teeth, the thick ends against the margin of the river, or against the cross-tree, while others plunge to the bottom, and dig holes with their fore feet, to receive the points, that they may stand on end. When some are labouring in this manner, others bring earth, which they plash with their feet, and beat firm with ther tails. They carry the earth in their mouths, and with their fore feet, and transport it in such quantities, that they fill with it all the intervals between the piles. These piles consist of several rows of stakes, of equal height, all placed opposite to each other, and extend from one bank of the river to the other. The stakes facing the under part of the river, are placed perpendicularly; but the rest of the work slopes upwards to sustain the pressure of the fluid; so that the bank, which is 10 or 12 feet wide at the base, is reduced to two or three at the top. It has therefore not only all the necessary thickness and solidity, but the most advantageous form for supporting the weight of the water, for preventing its issue, and to repel its efforts. Near the top, or thinnest part of the bank, they make two or three sloping holes, to allow the surface water to escape, and these they enlarge or contract, according as the river rises or falls; and when any breaches are made in the bank by sudden or violent inundations, they know how to repair them as soon as the water subsides.

It would be superfluous, after this account of their public work, to give a detail of their particular operations, were it not necessary in a history of these animals to mention every fact, and were not the first great structure made with a view to render their smaller habitations

more commodious. These cabins or houses are built upon piles near the margin of the pond, and have two openings, the one for going to the land, and the other for throwing themselves into the water. The form of the edifices is either oval or round, some of them larger and some less, varying from four or five, to eight or ten feet diameter. Some of them consist of three or four stories; and their walls are about two feet thick, raised perpendicularly upon planks, or plain stakes; which serve both for foundations and floors to their houses. When they consist but of one story, the walls rise perpendicularly a few feet only, afterwards assume a curved form, and terminate in a dome or vault, which serves them for a roof. They are built with amazing solidity, and neatly plaistered both without and within. They are impenetrable to rain, and resist the most impetuous winds. The partitions are covered with a kind of stucco, as nicely plaistered as if it had been executed by the hand of man. In the application of this mortar, their tails serve for trowels, and their feet for plashing. They employ different materials, as wood, stone, and a kind of sandy earth, which is not subject to be dissolved in water. The wood they use is almost all of the light and tender kinds, as alders, poplars, and willows, which generally grow on the banks of rivers, and are more easily barked, cut, and transported, than the heavier and more solid species of timber. When they once attack a tree, they never abandon it till they cut it down, and carry it off. They always begin the operation of cutting at a foot or a foot and a half above the ground: they labour in a sitting posture; and beside the convenience of this situation, they enjoy the pleasure of gnawing perpetually the bark and wood, which are most palatable to their taste; for they prefer fresh bark and tender wood to most of their ordinary aliment. Of these provisions they lay up ample stores, to support them during the winter; but they are not fond of dry wood. [The provision for eight or ten beavers, is twenty-five or thirty feet in length, by eight or ten feet in thickness. They transport not into their cabins wood or bark, till cut into thin slices, and just prepared for eating. They love fresh wood better than what has been floated, and go out from time to time, during the winter, to eat fresh provisions in the forests.] It is in the water, and near their habitations, that they establish their magazines. Each cabin has its own magazine, proportioned to the number of its inhabitants, who have all a common right to the store, and never pillage their neighbours. Some villages are composed of twenty or twenty-five cabins. But these large establishments are rare; and the common republic seldom exceeds ten or twelve families, of which each has his own quarter of the village, his own magazine, and his separate habitation. They allow not strangers to set down in their neighbourhood. The smallest cabins contain two, four, or six; and the largest eighteen, twenty, and it is alledged, sometimes thirty beavers. They are almost always equally paired, being the same number of females as of males. Thus upon a moderate computation, the society is often composed of 150 or 200, who all at first laboured jointly, in raising the great public building, and afterwards in select tribes or companies, in making particular habitations. In this society, however numerous, an universal peace is maintained. Their union is cemented by common labours; and it is rendered perpetual by mutual convenience, and the abundance of provisions which they amass and consume together. Moderate appetites, a simple taste, an aversion to blood and carnage, deprive them of the idea of rapine and war. They enjoy every possible good, while man knows only how to pant after happiness. Friends to each other, if they have some foreign enemies, they know how to avoid them. When danger approaches, they advertise one another, by striking their tail on the surface of the water, the noise of which is heard at a great distance, and resounds through all the vaults of their habitations. Each takes his part; some plunge into the lake, others conceal themselves within their walls, which can be penetrated only by the fire of heaven, or the steel of man, and which no animal will attempt either to open or to overturn. These retreats are not only very safe, but neat and commodious. The floors are spread over with verdure: the branches of the box and the fir serve them for carpets, upon which they permit not the smallest dirtiness. The window that faces the water answers for a balcony to receive the fresh air, and to bathe. During the greatest part of the day, they sit on end, with their head and anterior parts of the body elevated, and their posterior parts sunk in the water. This window is made with caution, the aperture of which is sufficiently raised to prevent its being stopped up with the ice, which, in the beaver climates, is often two or three feet thick. When this happens, they slope the sole of the window, cut obliquely the stakes which support it, and thus open a communication with the unfrozen water. This element is so necessary, or rather so agreeable to them, that they can seldom dispense with it. They often swim a long way under the ice: it is then that they are most easily taken, by attacking the cabin on one hand, and at the same time, watching at a hole made at some distance, where they are obliged to repair for the purposes of respiration. The continual habit of keeping their tail and posterior parts in the water, appears to have changed the nature of their flesh. That of their anterior parts, as far as the reins, has the taste and consistence of the flesh of land or air animals; but that of the tail and posteriors has the odour and all the other qualities of fish. The tail, which is a foot long, an inch thick, and five or six inches broad, is even an extremity or genuine portion of a fish attached to the body of a quadruped: it is entirely covered with scales,

and with a skin perfectly similar to that of large fishes. The scales may be scraped off with a knife, and after falling they leave an impression on the skin, which is the case with all fishes.

It is in the beginning of summer that the beavers assemble. They employ the months of July and August in the construction of their bank and cabins. They collect in September their provisions of bark and wood: afterwards they enjoy the fruits of their labours, and taste the sweets of domestic happiness. This is the time of repose and the season of love. Knowing and loving one another from habit, from the pleasures and fatigues of a common labour, each couple join not by chance, nor by the pressing necessities of nature, but unite from choice and from taste. They pass together the autumn and the winter: perfectly satisfied with each other, they never separate. At ease in their cabins, they go not out but upon agreeable or useful excursions, to bring in supplies of fresh bark, which they prefer to what is too dry or too much moistened with water. The females are said to continue pregnant four months; they bring forth in the end of winter, and generally produce two or three at a time. About this period they are left by the males, who retire to the country to enjoy the pleasures and the fruits of the spring. They return occasionally to their cabins; but dwell there no more. The mothers continue in their cabins, and are occupied in nursing, protecting, and rearing their young, which at the end of a few weeks are in a condition to follow their dams. The females in their turn make little excursions to recruit themselves by the air, by eating fishes, crabs, and fresh bark, and in this manner pass the summer upon the waters and in the woods. They assemble not again till autumn, unless their banks or cabins be overturned by inundations; for when accidents of this kind happen, they suddenly collect their forces in order to repair the breaches which have been made.

Some places they prefer to others for their habitation, and they have been observed, after having their labours frequently destroyed, to return every summer to repair them, till being fatigued with this persecution, and weakened by the loss of several of their numbers, they took the resolution of changing their abode, and of retiring to solitudes still more profound. It is in winter that they are chiefly sought by the hunters; because their fur is not perfectly sound in any other season: and after their village is ruined, and numbers of them are taken, the society is sometimes too much reduced to admit of a fresh establishment; but those which escape death or captivity disperse and become vagabond. Their genius, withered by fear, never again expands. They hide themselves and their talents in holes; or sunk to the condition of other animals, they lead a timid and a solitary life. Occupied only by pressing wants, and exerting solely their individual powers, they lose for ever those social qualities which we have been so justly admiring.

However marvellous the society and the operations I have now described may appear, it is impossible to doubt of their reality. All the facts mentioned by numbers of eye-witnesses correspond with those I have related: and if my narration differ from some which have been given, it is only in a few points that I judged too marvellous and improbable to be credited. Authors have not limited themselves to the social manners of the beavers, and to their evident talents for architecture, but have ascribed to them general ideas of police and of government. They have affirmed, that after the beavers have established a society, they reduce strangers and travellers of their own species into slavery; that these they employ to carry their earth and to drag their trees; that they treat in the same manner the lazy and old of their own society; that they turn them on their backs, and make them serve as vehicles for the carriage of their materials; that these republicans never associate but in an odd number, in order to have always a casting voice in their deliberations; that each tribe has its chief; that they have established sentinels for the public safety; that when pursued they tear off their testicles to satisfy the avarice of their hunters; that in this mutilated state they exhibit themselves to procure compassion from their persecutors, &c. In proportion as we reject with contempt those exaggerated fables, we must admit the facts which are established and confirmed by moral certainties. The works of this animal have been a thousand times viewed, measured, overturned, designed, and engraven. What is still more convincing, some of these singular works still subsist, though less common than when North America was first discovered, and have been seen by all the missionaries and all the latest travellers who have penetrated into the northern regions of that continent.

It is universally agreed, that beside the beavers who live in society there are in the same climate others who are solitary, and rejected, it is said, from the social state for their crimes, reaping none of its advantages, having neither house nor magazine, and living, like the badger, in holes under the ground. These solitary beavers are called *terriers*. They are easily distinguished by their dirty and tattered robe; for the hair of their back is rubbed off by the friction of the earth. They live, like the other kind, upon banks of waters, where some of them make a ditch of several feet deep, in order to form a pond that may reach to the mouth of their hole, which frequently exceeds 100 feet in length, and all along slopes upward, to facilitate their retreat, in proportion as the water rises during inundations. But there are other solitary beavers, which live at a considerable distance from the water. All our European beavers are terriers and solitary, and their fur is not nearly so valuable as

that of those which live in society. They differ in colour according to the climate they inhabit. In the northern deserts they are perfectly black, and their furs are finest; but even there some are found entirely white; others white spotted with gray, and others with a mixture of red upon the nape of the neck and haunches. In proportion as they recede from the north their colour turns clearer and more mixed. In the north of Canada they are chesnut coloured; farther south they are bay, and of a pale straw colour among the Ilionois. In America beavers are found from the 30th degree of north latitude to beyond the 60th. They are very frequent in the north, and gradually decrease as we advance southward. The same thing holds in the Old Continent: they never appear in numbers but in the northern regions; and they are very rare in France, Spain, Italy, Greece, and Egypt. They were known to the ancients. The religion of the Magi prohibited the killing of beavers. They were common on the margins of the Pontus Exinus, and were distinguished by the name of *Canes Pontici:* but they probably were not quiet enough in this situation, (for the coasts of this country have been frequented by men from the earliest periods of history), since their society and labours are mentioned by none of the ancients. Ælian in particular, who betrays so strong an affection for the marvellous, and who, I believe, first said that the beaver cut off his testicles to allow them to be collected by the hunters, would never have failed to mention the wonders of their republic, and their talents for architecture. Even Pliny himself, whose bold, sublime, and melancholy genius made him uniformly despise men to exalt nature, could not have abstained from comparing the labours of Romulus to those of the beavers. It is therefore apparent, that their industry in building was altogether unknown to the ancients; and although cabined beavers have lately been found in Norway, and in other northern regions of Europe, and though it is probable that the ancient beavers built as well as the modern; yet as the Romans never penetrated so far north, it is not surprising that their writers are silent on this subject.

Several authors have affirmed, that the beaver, being an aquatic animal, could not live upon land without water. But this notion is false; for the young beaver sent me from Canada was always kept in the house; and when first presented to water it was afraid, and refused to enter into that element. But after being forced, and retained in a bason, it grew so easy in a few minutes, that it made no attempts to get out; and when left at liberty it often returned to the water spontaneously. It likewise avails itself of the mire and moist pavements. One day he escaped, and descended by a stair into the subterraneous vaults in the royal garden. He continued for some time to swim in the stagnant water in the bottom of these vaults. However, as soon as he saw the light of the torches which were brought to search for him he returned to those who called him, and allowed himself quietly to be taken. He is familiar, without being caressing: he asks to eat from those who are at table; and his petitions consist of a small plaintive cry, and some gestures with his hand. When he receives a morsel, he carries off and conceals it, to be eaten at leisure. He sleeps pretty often, reposing on his belly. He eats every thing except flesh, which he constantly refuses, whether it be raw or roasted. He gnaws every thing he can find, stuffs, furniture, wood, &c.; and we have been obliged to line with a double coat of tinned iron the barrel in which he was transported.

Though the beavers prefer the margins of lakes, rivers, and other fresh waters; yet they are found on the sea-coasts, but principally on mediterranean gulfs which receive great rivers, where the water has not its usual saltness. They are hostile to the otter, whom they chace, and will not permit to appear in the waters they frequent. The fur of the beaver is finer and more bushy than that of the otter: it consists of two kinds of hair; the one, which is short, but bushy, fine as down, and impenetrable by water, immediately covers the skin; the other, which is longer, firmer, more splendid, but thinner, serves the former as a surtout, defending it from dust and dirt. This second kind of hair is of little value; it is the first alone that is employed in our manufactures. The black furs are generally most bushy, and consequently in greatest esteem. The fur of the terrier beaver is much inferior to that of the cabin-building kind. The beavers, like all other quadrupeds, cast their hair in summer; and the furs of those caught during this season are of little value. The fur of the white beaver is greatly esteemed on account of its rarity; and the perfectly black furs are nearly as rare as the white.

But beside the fur, which is the most precious article, the beaver furnishes a matter of which great use has been made in medicine. This matter, called *castoreum*, is contained in two large bags or bladders, which the ancients mistook for the testicles of the animal. We shall here give neither the description nor the uses of that substance, because they are to be found in all our dispensatories. The savages, it is said, extract an oil from the tail of the beaver, and use it as a topical application for several diseases. The flesh of the beaver, though fat and delicate, has always a disagreeable flavour. Their bones are said to be excessively hard; but concerning this fact we have had no opportunities of determining, because we dissected only a young one. Their teeth are very hard, and so sharp, that they are used by the savages as knives to cut, hollow, and polish their timber. The savages clothe themselves with beavers skins; and in winter turn the shaggy side inward; and

these, from their having imbibed much sweat from the perspiration of their wearers, are called *fat beaver*, or *coat beaver*, and are employed for coarse works only.

The beaver uses his fore feet, like hands, with equal dexterity as the squirrel, the toes being well separated; but those of the hind feet are united by a membrane. These they employ as fins, and extend them like the toes of a goose, which animal they resemble in their walking upon land. The beaver swims better than he runs: as his fore legs are much shorter than the hind ones, he always walks with his head low, and his back arched. His senses are extremely delicate, especially the sense of smelling. Dirtiness and bad smells seem to be perfectly unsupportable to him. When retained in confinement too long, and obliged to void his excrements, he places them near the threshold of the door, and as soon as it is opened, he pushes them out. This habit of cleanliness is natural to them; and our young beaver never failed in this manner to clean his habitation. At the age of twelve months, he exhibited marks of ardour for a female, which renders it probable that he had then nearly attained his full growth. Hence the duration of life in these animals cannot be very long; perhaps it is too much to extend it to fifteen or twenty years. It is not astonishing that this beaver was smaller than others of his age, having been perpetually confined almost from his birth; and being unacquainted with water till he was nine months old, he could neither grow nor expand like those who enjoy liberty and the use of that element, which appears to be equally necessary to them as the land.

SUPPLEMENT.

We formerly remarked, that the beavers were common to both Continents; and they are, in fact, as frequent in Siberia as in Canada. They may be easily tamed, and even taught to fish, and to bring home their prey to the family. M. Kalm assures us of this fact:

'I have seen in America,' says he, 'beavers so fully 'tamed, that when sent out to fish, they brought home 'the booty to their master. I have also seen others which 'were so familiar with their masters, and with the dogs, 'that they followed them, accompanied them in the 'boats, jumped into the water, and in a moment after, 'returned with a fish.'

'We have seen,' says M. Gmelin, 'in a small village 'of Siberia, a beaver that was brought up in the house, 'and was so exceedingly tractable, that he sometimes 'made voyages to a considerable distance, decoyed fe-'males, and brought them home; after the season of 'love was over, these females returned without any con-'ductor.'

THE RACCOON.

THIS animal has a black sharp pointed nose; upper jaw longer; ears short, and rounded; eyes surrounded with two broad patches of black; from the forehead to the nose, a dusky line; face, cheeks, and chin, white; upper part of the body covered with hair, ash-coloured at the root, whitish in the middle, and tipt with black; tail very bushy, annulated with black; toes black, and quite divided.

Several authors have described this animal under the name of *Coati*. But to prevent its being confounded with the true *Coati*, or even with the *Coati-mondi*, we have adopted its English name.

The raccoon which we have had alive, and kept him twelve months, was of the size and figure of a small badger. His body is thick and short, and the hair long, bushy, black at the points, and gray underneath. His head resembles that of the fox; but his ears are round and much shorter. The eyes are large, and of a yellowish green colour. Above the eyes, a black band runs across; the muzzle is slender, the nose somewhat turned up, and the upper lip advances beyond the under one. He has, like the dog, six cutting teeth, and two canine in each jaw. The tail is bushy, as long as the body, and marked alternately with black and white rings through its whole extent. The fore legs are much shorter than the hind ones; and there are five toes, armed with strong sharp claws, on each foot. The hind feet rest so much on the heel, that the animal can elevate and support his body in a position inclined forwards. He uses the fore feet in carrying food to his mouth. But as his toes are rigid, and have little flexibility, he uses both hands at a time in laying hold of what is given him. Though thick and short, he is very agile: his claws, which are sharp as thorns, enable him to climb trees with great facility. He mounts the trunk with alacrity, and runs to the extremities of the branches. He goes by leaps, rather gambols than walks, and his movements, though oblique, are quick and light.

This animal is a native of the southern parts of America. He is never found in the Ancient Continent; at least, those travellers who have described the animals of Africa and the East Indies make no mention of him.

But he is very common in the warm regions of America, and particularly in Jamaica, where he lives in the mountains, from which he descends to eat the sugar canes. He appears not in Canada, nor in the northern parts of the Continent; and yet he can support excessive cold. M. Klein kept one at Dantzic; and the one in my possession has passed a whole night with his feet frozen in ice, without suffering any injury.

The raccoon softens, or rather dilutes, in water every thing he intends to eat. He throws his bread into the bason that holds his water; and unless pressed with hunger, he does not remove it till it be well soaked. But when very hungry, he eats dry food, or any thing that is presented to him. He searches about, and eats every thing that he can find, as flesh, either crude or prepared, fishes, eggs, living fowls, grain, roots, &c. He likewise devours all kinds of insects. He delights in hunting spiders; and when at liberty in the garden, he eats grasshoppers, snails, and worms. He loves sugar, milk, and other soft kinds of nourishment, except fruits; but all these he rejects, when he can have flesh or fish. He retires to a distance to obey the calls of nature. He is familiar, and even caressing; for he leaps upon those he is fond of, playing spontaneously, and perpetually moving about with great agility. He appears to have much of the nature of the maki, and to possess some of the qualities of the dog.

SUPPLEMENT.

Concerning the raccoon, I have received the following communication from M. Blanquart des Salines, in a letter dated Calais, October 29, 1775.

'My raccoon, before he came into my possession, had always been chained. In this state of captivity, he was very gentle, but had little inclination to caress. The people of the house were all equally kind to him; but he received them differently; for what pleased him in one, he revolted against in another; and in this his conduct was invariable.

'His chain sometimes broke; and liberty rendered him insolent. He took possession of an apartment, would allow none to enter, and it was with some difficulty that he could again be reconciled to bondage. Since he came under my management, I have frequently given him his liberty. Without losing sight of him, I allowed him to walk about with his chain; and each time his gratitude was expressed by a thousand caressing gambols. But this is by no means the case when he makes his escape himself. He then roams about, sometimes for three or four days together, upon the roofs of the neighbouring houses, descends during the night time into the court yards, enters the hen houses, strangles all the poultry, and eats their heads. His chain does not render him more humane, but only more circumspect. He then employs every artifice to make the fowls grow familiar with him; he permits them to partake of his victuals; and it is only after having inspired them with the highest notions of security, that he seizes one, and tears it in pieces. Some young cats have met with the same fate. The motions of this animal, though light, are always oblique; and I doubt if he can overtake other animals by running. He opens oysters with wonderful dexterity. His sense of touching must be exquisite. In all his little operations, he seldom uses either his nose or his eyes. For example, he makes an oyster pass under his hind paws; then without looking at it, he searches with his hands for the weakest part; there he sinks his claws, separates the shells, and leaves not a vestige of the fish. In all this operation, neither his eyes nor his nose, which he keeps at a distance, are of the least use to him.

'This raccoon is not very grateful for the caresses he receives; but is extremely sensible of bad treatment. A servant one day gave him several lashes with a whip. But this man has ever since endeavoured in vain to accomplish a reconciliation. Neither eggs nor fishes, of which the animal is exceedingly fond, can appease his resentment. At the approach of the servant, the raccoon flies into a rage; his eyes kindle; he springs at the man, utters most dolorous cries, and rejects every thing presented to him, till the disagreeable object disappears. The accents of his rage are very singular, sometimes resembling the whistling noise of the curlew, and sometimes the hoarse barking of an old dog.

'If any person strikes him, or if he is attacked by an animal that he thinks stronger than himself, he makes no resistance; but like the hedge-hog, conceals his head and feet by rolling up his body in the form of a ball; no complaint escapes him; and in this position, he calmly submits to be killed.

'I remarked, that he never allowed hay or straw to remain in his nest; but chose rather to lie upon wood. When litter is put in, he instantly throws it out. I never perceived that cold made him uneasy. Of three winters, he has passed two exposed to all the rigours of the air. I have seen him covered with snow, having no shelter, and yet in good health. I imagine that he is not solicitous about heat. During the last frosts, I presented to him warm water, and water almost frozen, for diluting his food; but he uniformly preferred the latter. He had liberty of sleeping in the stable; but he often preferred a corner of the court.

'The defect of saliva, or having but a small quantity of it, is, I imagine, the reason why this animal dilutes his food with water. He never wets fresh or bloody meat, nor a peach, nor a raisin. But he plunges every thing that is dry into his bason.

'He abhors children; their crying irritates him; and he makes every effort to spring upon them. A small bitch of which he is fond, he chastises severely when

she barks too loud. I know not why several animals equally detest sharp cries. In the year 1770 I had five white mice. I happened to make one of them cry; the others attacked it: I continued to make it cry, and they killed it.

'This raccoon is a female; she comes in season in the beginning of summer, and her ardour for the male continues six weeks. During this period nothing can quiet her; every object is disgusting; and she hardly takes nourishment. A hundred times each day she passes between her thighs and between her fore-feet her bushy tail, which she seizes by the end with her teeth, and agitates perpetually, to give friction to the parts.

'This animal acquires not its full growth till it be two years and a half old.'

THE COATI, OR BRASILIAN WEASEL.

WEASEL with the upper jaw lengthened into a pliant moveable proboscis, much longer than the lower jaw; ears rounded; eyes small; nose dusky; hair on the body smooth, soft, and glossy, of a bright bay colour; tail annulated with dusky and bay; breast whitish; length from nose to tail eighteen inches; tail thirteen inches.

This animal has been called *Coati-mondi* by several authors. We have had it alive; and after comparing it with the coati mentioned by Thevet, and described by Marcgrave, we discovered the coati and coati-mondi to be only varieties of the same species; for Marcgrave, after describing the coati, says that there are other coati of a dark brown colour, called for the sake of distinction coati-mondi by the Brasilians. He admits not therefore any other difference between the coati and coati-mondi but that of the colour of the hair; and hence they can be regarded as varieties only of the same species.

The coati is very different from the raccoon described in the preceding article. He is of a smaller stature; his body and neck, head and muzzle, are much longer; the upper jaw is terminated by a kind of moveable snout, which stretches an inch or an inch and a half beyond the extremity of the under jaw. This turned-up snout, joined to the length of the jaws, gives to the muzzle a curved and elevated appearance. The coati has also smaller eyes than the raccoon, shorter ears, longer, coarser, and less variegated hair, shorter legs, and longer feet; and it rests still more upon the heel. Like the raccoon, it has an annulated tail, and five toes on each foot. [Some coatis have the tail of one uniform colour; but as there are no other differences, they must be considered as varieties only and not as distinct species.]

Some authors regard the sow-badger as a coati, and have added to this genus the *taxus suillus*, of which Aldrovandus has given a figure. But when it is considered that the sow-badger mentioned by hunters is supposed to be found in France, and even in colder European climates, and that, on the contrary, the coati never appears but in the southern climates of the New Continent, this notion must be rejected as having no foundation to support it; for the figure given by Aldrovandus is nothing more than that of a badger with the addition of a sow's snout. The author pretends not to have drawn this animal from nature; and he has not described it. The long muzzle and moveable snout sufficiently distinguish the coati from all other animals. Like the bear the coati stands with ease on his hind feet, resting upon his broad heels, which are terminated by large callosities, extending outward, and augmenting the base of the feet.

The coati has a trick of gnawing his own tail, which, when not mutilated, exceeds the length of the body; he generally carries his tail erect, and sweeps it about from side to side. This remarkable practice of gnawing the tail is not however peculiar to the coati; the monkeys, the *makis*, and some other animals which have long tails, shorten them one third, or one fourth, by eating both the flesh and the vertebræ. This circumstance gave rise to a general conclusion, that in very long members, the extremities of which are of course removed to a great distance from the centre of sensation, the feeling is weak, and that this weakness of feeling is proportioned to the distance and the thinness of the part; for if the extremity of the tail in those animals was very sensible, the pain excited would be stronger than the desire of mutilation, and they would preserve their tails with equal anxiety as the other parts of their bodies. Upon the whole the coati is an animal of prey, which lives upon flesh and blood, and which, like the fox or martin, devours small animals and fowls, eats eggs, and hunts for the nests of birds; and it is probably from this conformity of disposition, rather than from any resemblance to the martin, that the coati has been considered as a small species of the fox.

THE AGOUTI, OR LONG-NOSED CAVY.

CAVY with a long nose; divided upper lip; short rounded lips; black eyes; hair hard and shining; on the body mixed with red, brown, and black; on the rump, of a bright orange colour; belly yellow; legs almost naked, slender, and black; four toes on the fore-feet, three on the hind; tail short and naked; size of a rabbit.

This animal is about the size of a hare, and has been regarded by most systematic writers as a species of rabbit or large rat. These animals, however, it resembles in some minute characters only; but in natural dispositions it differs essentially from them both. It has the rudeness of hair, the grunting, and likewise the voracious appetite of a hog; and when fully glutted, it conceals, like the fox, the remainder of its food in different places. The agouti delights in cutting and gnawing every thing he meets with. When irritated the hair of his back rises, and he strikes the ground forcibly with his hind feet. His bite is cruel. He digs not a hole, like the rabbit, nor sits on the ground like the hare; but generally lives in the hollows of decayed trees. Fruits, potatoes, and manioc, are the common food of those which live near the habitations of men. But those which live in the woods and savannas feed upon leaves and roots, plants and shrubs. The agouti, like the squirrel, uses his fore feet in holding his food, and carrying it to his mouth. He runs very nimbly both on plain and rising grounds. But as his fore legs are much shorter than his hind legs, he would tumble headlong if he did not slacken his course in descending. Both his eye and his ear are fine. He stops and listens to the sound of music. The flesh of those which are fat and well fed is not very bad, though it be hard and not very agreeable to the taste. They scald the agouti, and make him ready, in the same manner as a pig. He is hunted with dogs. When forced among the cut sugar canes he is soon taken; because these grounds being generally covered a foot thick with straw and leaves, at each leap he sinks in this litter, so that a man may overtake and slay him with a stick. He commonly runs very nimbly before the dogs; and when he gains his retreat he lies squat, and remains obstinately in his concealment. The hunters are obliged to chase him out by filling his hole with smoke: the animal, half suffocated utters mournful cries; but never issues forth, unless when pushed to the last extremity. His cry, which he often repeats when disturbed or irritated, resembles that of a small hog. If taken young he is easily tamed, and goes out and returns of his own accord. These animals commonly reside in the woods and hedges; where the females choose a place well covered and bushy, and there prepare a bed of leaves and hay for their young. They annually produce two or three, but generally two. Like the cats they transport their young, two or three days after birth, into the hollows of trees, where they suckle them for a short time. The young are soon in a condition to follow their mother, and to search for food. Thus their time of growth is short; and consequently the duration of their lives cannot be long.

The agouti appears to be an animal peculiar to the southern parts of America, as none of them are ever found in the old world. They are common in Brasil, in Guiana, in St. Domingo, and in all the islands. They seem to require a warm climate in order to subsist and to multiply. They can live, however, in France, if kept in a dry place, and sheltered from the winter frosts. Even in America they appear not in the temperate or cold regions. In the islands there is only the species of agouti which we have described. But at Cayenne, and in Guinea and Brasil, a second species is mentioned called *Agouchi*, which is said to be uniformly smaller than the first. But we are assured, by the evidence of persons who have lived long at Cayenne, and who know both the agouti and agouchi, the latter of which we have never been able to procure, that the animal we have described is the true agouti. We had it alive: it was as large as a rabbit; its hair was rude, and of a brown colour, a little mixed with red. Its upper lip was divided like that of the hare: its tail was still shorter than the tail of the rabbit: the ears were short and broad. The upper jaw advanced beyond the under: the muzzle resembled that of the dormouse, and the teeth those of the marmot. The neck was long, and the legs slender: it had four toes on the fore and three on the hind feet. Marcgrave and most naturalists after him have asserted, that the agouti had six toes on the hind feet. M. Brisson is the only writer who has not copied this error of Marcgrave: having described the animal from nature, he found, as we did, only three toes on the hind feet.

SUPPLEMENT.

We have little to add concerning the agouti; M. de la Borde informs us, that in Guiana it is the most common quadruped, all the woods, plains, heights, and even the marshes, being full of these animals.

'The Agouti,' says he, 'is about the size of a hare; his skin is hard, and lasts very long when employed as

an upper leather to shoes. He has no grease: his flesh is as white and nearly as good as that of the rabbit, having the same taste and flavour. Whether old or young, their flesh is always tender; but those which inhabit the sea coast are best. They are taken in traps, or hunted with dogs. The Indians and Negroes, who know how to allure them by whistling, or imitating their cries, kill as many of them as they please. When pursued, they conceal themselves, like the rabbits, in the holes of old trees. They hold their food in their paws, like the squirrels. Their ordinary food, which they often conceal in the earth, to be used occasionally, are the nuts of the maripa, of the tourlovri, of the corana, &c.; and after concealing these nuts, they often touch them not for six months. They multiply as fast as the rabbits, producing three, four, and sometimes five young ones, during every season of the year. They live not in numbers in the same hole; but they are either found alone, or the mother with her young. They are easily tamed, and eat almost every thing. When in a domestic state, they remove not to any great distance, and always return to the house spontaneously. But they constantly retain a little of their savage disposition. In general, they remain in their holes during the night, unless the moon shines bright; but they run about during most of the day. There are some countries, as about the mouth of the river of the Amazones, where these animals are so numerous, that they are often met with in scores.

THE LION.

CAT with a large head; short rounded ears; face covered with short hairs; upper part of the head, chin, whole neck and shoulders, with long shaggy hairs, like a mane; hair on the body, and limbs short and smooth; along the bottom of the belly long; limbs of vast strength; tail long, with a tuft of long hairs at the end; colour tawny, but on the belly inclines to white; length of the largest lion, from nose to tail, above eight feet; the tail four feet: the lioness or female is less, and wants the mane.

The influence of climate, in the human species, is marked only by slight varieties; because this species is single, and extremely distinct from every other. Man, white in Europe, black in Africa, yellow in Asia, and red in America, is the same animal, tinctured with the colour peculiar to the climate. As he is formed to exercise dominion over the earth, and as he has the whole globe for his habitation, his nature seems to be accommodated to every situation. Under the fervours of the south, or the frozen regions of the north, he lives, multiplies, and is so universally and so anciently diffused over every country, that he appears to have no peculiar climate. Among the other animals, on the contrary, the influence of climate is stronger, and marked by sensible characters; because they differ in species, and their nature is perfect, and less diffused than that of man. The varieties of each species are not only more numerous, and more strongly marked, but even the differences of species themselves seem to depend upon the differences of climate. Some are unable to propagate but in warm, and others cannot subsist but in cold countries. The lion never inhabited the northern regions; the rein deer was never found in the south; and perhaps no other species but that of man is generally diffused over the whole surface of the globe. Each has its peculiar country, to which it is confined by a physical necessity; each is a genuine son of the country it inhabits; and it is in this sense alone, that particular animals ought to be called natives of a particular climate.

In warm countries, the land animals are larger and stronger than in the frozen or temperate regions. They are likewise more hardy and ferocious. All their natural qualities seem to originate from the ardour of the climate. Lions, born under the scorching heats of Africa or the Indies, are the strongest, the fiercest, and the most formidable. Our wolves, and other carnivorous animals, would hardly have the merit of being his providers. The lions of America, if they deserve that name, are, like the climate, infinitely more mild than those of Africa; and what proves that the excess of their ferocity originates from the excess of heat, is, that in the same country, those who inhabit the high mountains, where the air is temperate, differ in disposition from those who live in the plains, where the heat is extreme. The lions of Mount Atlas, the summit of which is sometimes covered with snow, have neither the courage, the strength, nor the ferocity of the lions of Bile-dulgerid or of Zaara, whose plains are covered with burning sands. It is chiefly in these fervid deserts that we meet with those terrible lions, who are the dread of travellers, and the scourge of the neighbouring provinces. Happily the species is not numerous: it even

appears to diminish daily; for from the testimony of those who have traversed this part of Africa, the number of lions is not nearly so great as formerly. The Romans, says Mr. Shaw, drew from Lybia, for their public spectacles, fifty times more lions than could now be found in that country. It has likewise been remarked, that in Turkey, Persia, and India, lions are much less frequent than they were in ancient times: and as this bold and powerful creature preys on every other animal, and is himself a prey to none, the diminution of the species can only be attributed to the increase of the numbers of mankind; for it must be allowed, that the strength of the king of animals is not match against the address of a Hottentot or a Negro, who often attack him, face to face, with very light weapons. The lion, having no enemy but man, and his species being reduced to a fiftieth, or if you will, to a tenth part of its former standard, it follows, that the human species, instead of having suffered any considerable diminution since the time of the Romans, (as has been often alledged), is on the contrary increased, even in such countries as Lybia, where the power of man appeared to have been greater during the æra of Carthage, than it is now under that of Tunis and Algiers.

Man's industry augments in proportion to his numbers; but that of the other animals remains always the same. All the destructive species, as that of the lion, seem to be banished to distant regions, or reduced to a small number, not only because mankind have increased, but because they have also become more powerful, and have invented formidable arms which nothing can resist. Would to God man had never combined the operations of steel and fire for other purposes than those of destroying lions and tigers!

This superiority of man in numbers, and in industry, which has impaired the force of the lion, has likewise enervated his courage. Among animals this latter quality, though natural, rises or falls according as the exertions of their strength are successful or abortive. In the vast deserts of Zaara, in those which seem to separate two very different races of men, the Negroes and the Moors, in the unpeopled regions that lie about the territories of the Hottentots, and in general, in all those southern parts of Africa and Asia, which man has disdained to inhabit, the lions are still very numerous, and continue in their natural state. Accustomed to measure their strength with that of every animal they meet, the habit of conquering renders them terrible and intrepid. Being ignorant of the power of man, they are not afraid to encounter him. Having never experienced the force of his arms, they hold them in defiance. Wounds enrage, without terrifying them. They are not disconcerted even by the appearance of numbers. A single lion of the desert often attacks a whole caravan; and if after a violent and obstinate engagement he finds himself fatigued, instead of flying, he retreats fighting, always opposing himself to the enemy. Those lions, on the other hand, who dwell in the neighbourhood of the towns or villages of India or Barbary, being acquainted with man, and the power of his arms, have lost their native fortitude to such a degree, that they fly from the threatenings of his voice, and dare not attack him. They content themselves with seizing small cattle, and even fly before the women and children, who make them indignantly quit their prey, by striking them with clubs.

This change, this softening in the temper of the lion, indicates that he is susceptible of the impressions he receives, and that he must possess a docility sufficient to render him tameable to a certain degree, and to admit of a species of education: and history informs us, that lions have been yoked in triumphal cars, and conducted to the battle or the chase; and that faithful to their masters, they never exerted their strength or their courage but in opposition to the common enemy. This much is certain, that the lion when taken young, and brought up among domestic animals, is easily accustomed to live, and even to sport innocently with them; that he is gentle and caressing to his master; and that if he sometimes resumes his natural ferocity, he seldom turns his rage against his benefactors. As his movements are impetuous, and his appetites vehement, we ought not to presume that they can always be balanced by the impressions of education. It is dangerous therefore to allow him to want food too long, or to irritate him unnecessarily. Bad treatment not only enrages him, but he remembers it, and seems to meditate revenge, in the same manner as he remembers and requites benefits received. Here I might quote a great number of particular facts, some of which appear to be exaggerated; but the whole, when combined, are sufficient to prove, that the anger of the lion is noble, his courage magnanimous, and his temper susceptible of impressions. He has often been known to disdain the insults, and to pardon the offensive liberties of weak enemies. When led into captivity, he discovers symptoms of uneasiness, without anger or peevishness; on the contrary, he assumes habits of gentleness, obeys his master, caresses the hand that feeds him, and sometimes pardons the animals which are thrown to him for prey. By this act of generosity, he seems to consider himself as for ever bound to protect them; he lives peaceably with them, allows them a part, and sometimes the whole of his food, and will rather submit to the gnawings of hunger than destroy the fruit of his own beneficence.

The lion cannot justly be branded with cruelty, since he acts from necessity, and kills no more than he consumes; while the tiger, the wolf, the hyæna, and many other inferior species, such as the fox, the martin, the

polecat, the ferret, &c. delight in slaughter, and seem rather to gratify their rage than their hunger.

The external appearance of the lion detracts not from the noble and generous qualities of his mind. His figure is respectable, his looks firm and determined, his gait stately, and his voice tremendous. His bulk is not excessive, like that of the elephant or rhinoceros. He is not gross and unwieldy, like the hippopotamus or the ox, nor too contracted, like the hyæna or the bear, nor lengthened to deformity, like the camel. The body of the lion, on the contrary, is so well poised and proportioned that it may be regarded as a perfect model of strength combined with agility: equally solid and springy, neither surcharged with fat nor with flesh, and containing nothing superfluous, he seems to be constituted entirely of nerves and of muscles. This great muscular force is manifested by the prodigious leaps and bounds which he performs with ease; by the brisk movements of his tail, a single sweep of which is sufficient to throw a man to the ground; by the facility with which he moves the skin of his face, and especially that of his front, which heightens greatly the expression of fury; and lastly, by the power of moving the hair of his mane, which he not only erects, but agitates on all sides, when he is enraged.

To all these splendid individual qualities of the lion we may add the nobleness of his speices. By noble species in nature, I mean those which are constant, invariable, and liable to no suspicion of degradation. These species are commonly singular, and of themselves constitute a genus. They are distinguished by characters so deeply marked, that they can be neither mistaken, nor confounded with any other. To begin with man, who is the noblest being of the creation, his species is single, since men of all races, of all climates, and of all colours, can mix and propagate together; and at the same time no animal can be said to make any approaches to the human species by natural relation. In the horse the species is not so noble as the individual; because he is so nearly approached by the ass, that a junction of the two produces individuals whom nature treats as bastards, unworthy of the genuine race, and renders incapable of perpetuating either species of which they are the issue; but as proceeding from a mixture of the two, they fail not to demonstrate the great affinity between them. In the dog the species is perhaps still less noble, because it seems to be allied to those of the wolf, the fox, and jackall, who all may be regarded as degenerated branches of the same family. In descending gradually to the inferior species, as those of the rabbit, weasel, rat, &c. we shall find, that each particular species has a number of collateral branches, of which we are unable to discover the genuine root. Lastly, in the insects, which ought to be regarded as the lowest species in nature, each kind is accompanied with so many neighbouring species, that we are obliged to denominate them by genera only. This is the chief use of methodical distributions, which ought not to be employed except in difficult enumerations of the smallest objects in nature, but which become totally useless, and even ridiculous, in treating of the particular tribes. To class a man with the monkey, or so say that the lion is *a cat with a long mane and tail*, is to degrade and to disfigure, instead of describing or denominating the objects of nature.

The species of the lion therefore is one of the most noble, because it is single, and cannot be confounded with those of the tiger, leopard, ounce, &c. These species, which seem to be the least removed from the lion, are so little distinguished from each other, that they have often been confounded by travellers.

The largest lions are about eight or nine feet long, by four or five feet high, and the tail is about four feet long. The small sized lions are about five feet and a half long, by three and a half feet high, and the tail is about three and a half feet in length. The lioness, in all dimensions, is about one fourth part less than the lion.

Aristotle distinguishes lions into the greater and the smaller; the latter, he remarks, are proportionally shorter in the body, have their hair more crisped, and are less courageous than the former. He adds, that in general all lions are of a yellow colour. The first of these facts seems to be doubtful; for no traveller mentions lions with crisped hair: some authors, who in other respects appear not to merit entire confidence, talk of a tiger with crisped hair, which is found at the Cape of Good Hope. But almost all authors agree as to the colour of the lion, which is yellow on the back, and whitish on the sides and belly. Ælian and Opian, however, affirm, that the Ethiopian lions are as black as the men; that in India there are lions entirely white, and others spotted with different colours, as red, black, and blue. But this seems not to be supported by any authentic evidence; for Marc Paul, the Venetian, speaks not of these spotted lions as if he had seen them; and Gesner properly remarks, that he only followed Ælian. It appears, on the contrary, that there are little or no varieties in this species; that the lions of Africa and of Asia are perfectly similar; and that the lions of the mountains differ from those of the plains in stature only and not in colour.

The lion has a mane, or rather long hair, which covers almost all the anterior parts of his body, and grows always longer as he advances in age. But the lioness, however old, has no mane. The American animal, called *a lion* by the Europeans, and *puma* by the natives of Peru, has no mane, and is also smaller, weaker, and less courageous than the true lion. It is not impossible that the mildness of this region of South America should

have had such influence on the nature of the lion, as to deprive him of his mane, and diminish both his courage and his stature. But it seems to be an absolute impossiblity that this animal, who inhabits the countries within the tropics only, and against whom nature appears to have shut up every avenue to the north, should have passed from the southern regions of Asia or Africa into America, these continents being divided from each other towards the south by immense oceans. Hence we are led to conclude, that the puma is not a lion sprung from those of the old world, and degenerated by the influence of the climate of America, but that he is an animal peculiar to America, like most animals of the New Continent. When the Europeans first discovered America, they found the quadrupeds, birds, fishes, insects, plants, and almost every thing, perfectly different from those of Europe. It was therefore necessary to denominate the principal objects of this new world. The names given them by the natives were mostly barbarous, and very difficult to pronounce or to remember. The names of objects were of course borrowed from those of the European languages, and especially from the Spanish and Portuguese. In this penury of denomination, the smallest analogy in external figure or in stature is sufficient to make us attribute to unknown objects the names of those with which we are acquainted. This gives rise to endless uncertainties and confusion, which are still further augmented, not only by giving to the productions of the new world the denominations of those of the old, but by the continual transportation of European plants and animals into America. To obviate these difficulties, we ought carefully to distinguish what belongs to the one continent from what belongs to the other, and to avoid the deceptions originating from improper denominations. We shall perceive the necessity of this discrimination in the subsequent article, where an enumeration of the animals peculiar to both continents shall be given.

M. de la Condamine, whose evidence merits the highest credit, says expressly, that he knows not whether the American animal called *a lion* by the Spaniards, and *puma* by the natives of Quito, deserves the name of a lion: he adds, that it is much smaller than the African lion, and that the male has no mane. Fresier likewise informs us, that the animals called *lions* in Peru are very different from those of Africa; that they fly upon the approach of man; and that they are dreadful to the flocks only; he farther remarks, that their head somewhat resembles both the hea' of the wolf and of the tiger; and that their tail is less than the tail of either of these animals. We learn, from more ancient relations, that the American lions have no resemblance to those of Africa; that they have neither the stature nor the boldness of the true lion; that they are neither red nor yellow, but of a gray colour; that they have no manes, and are accustomed to climb trees. Hence these animals differ from the lion in stature, in colour, in the form of the head, in the length of the tail, in the want of manes, and in their manners and dispositions. Characters so numerous and so essential ought for ever to prevent us from confounding the puma of America with the genuine lion of Africa or of Asia.

Though this noble animal inhabits the warmest climates only he can subsist for a great length of time in temperate countries, and perhaps with some attention might even be enabled to propagate. Gesner relates, that lions were brought forth in the menagerie of Florence; and Willoughby tells us, that in Naples a lioness that had been impregnated by a lion in the same den brought forth five whelps at one litter. These examples are rare; but if true, they prove that lions are not absolute strangers to a temperate climate. None of them however exist in the southern parts of Europe: in the age of Homer there were no lions in the Peloponnesus, although they were then, and even in the days of Aristotle, in Thrace, in Macedonia, and in Thessaly. It is apparent therefore, that in all ages they preferred the hot climates; that they seldom lived in temperate countries; and that they never inhabited the more northern regions. The naturalists above quoted, who speak of lions brought forth at Florence and Naples, are silent as to the time of the female's gestation, the size of the new-born whelps, and the quickness or slowness of their growth. Ælian limits the time of gestation to two months; but Philostratus and Edward Wotton extend it to six. I am inclined to be of the latter opinion; for the lion is an animal of great magnitude; and we know that in general, among larger animals, the time of gestation is longer than among the smaller species. The same thing takes place with regard to the growth of the body. Both ancients and moderns agree, that new-born lions are very small, being about the size of a weasel, that is, six or seven inches in length. They must, therefore, require several years before they can grow eight or nine feet long. The young lions are likewise said to be two months old before they can walk. Without giving implicit faith to these facts, we may with probability presume, that the lion, from the largeness of his body, must require three or four years in acquiring his full growth, and that he ought to live about seven times three or four years, or nearly to the age of twenty-five. The Sieur de St. Martin, master of the bull-fights at Paris, assures me that he has kept lions sixteen or seventeen years; and he imagines that they live not above the age of twenty or twenty-two. He has kept others twelve or fifteen years; and it is well known that their lives must be abridged, and their constitution weakened, by the want of exercise, confinement, and chagrin.

Aristotle affirms, in two different parts of his works,

that the lioness produces five or six whelps at the first litter, four or five at the second, three or four at the third, and two or three at the fourth; and that after this last litter, which is always the least numerous, she becomes barren. This assertion merits no credit; for in all animals, the first and last litters are less numerous than the intermediate ones. This philosopher erred, as well as all the naturalists who came after him, when he maintained that the lioness had two paps only; for it is now certain that she has four. He likewise affirms, that the lion, the bear, and the fox, are brought forth in an unformed state: but it is now past a doubt, that these creatures are as well formed at birth as any other animals, and that all the members are distinctly unfolded. Lastly, he affirms, that the lions copulate in a reversed manner; but from a bare inspection of the parts of the male, it is evident, that the lion must copulate in the ordinary way of other quadrupeds. I have mentioned these slight errors of Aristotle, because the authority of this great man has deceived all the writers on natural history since his time. What he remarks of the lion's neck being composed of one rigid and inflexible bone, has also been contradicted by experience; for in every quadruped, without exception, and even in man, the neck consists precisely of seven vertebræ. It is another general fact, that the necks of carnivorous animals are shorter than those of the frugivorous, and particularly of the ruminating species. But this difference in the length of the neck depends on the largeness of each vertebræ, and not on their number, which is always the same, from the elephant to the mole. With regard to the solidity of the lion's bones, which Aristotle affirms to have neither marrow nor cavity; to their hardness, which he compares to that of flint; and to their property of striking fire with steel; these blunders ought not to have been repeated by Kolbe; nor should they have come down to our time; since, even in the days of Aristotle, they were ridiculed by Epicurus.

The lions are exceedingly ardent in their amours. When the female is in season, she is sometimes followed by eight or ten males, who incessantly roar around her, and engage in the most furious combats, till one of them conquers all the rest, and retires in peaceable possession of his mate. The lioness brings forth in the spring, and produces but once in the year; which shows that she is occupied for some months in suckling and taking care of her young; and consequently that the time of their growing, when they need the assistance of the mother, is at least several months.

In these animals, all the passions, even those of the softest kind, are excessive. The maternal affection of the lioness is extreme. Though naturally weaker, and less courageous than the lion, whenever she has young, she becomes dreadfully ferocious. She then exposes herself with more boldness than the lion; she knows no danger; she attacks indiscriminately, men and every other animal; and after slaying them, carries them home to her whelps, whom she soon accustoms to suck the blood and tear the flesh. She commonly brings forth in places the most sequestered and inaccessible; and when afraid of being discovered, she conceals the tracks of her feet, by returning several times on her steps, or effaces them with her tail. When her anxiety is great, she sometimes transports her young to a different place; and if the hunters attempt to force them from her, she becomes perfectly furious, and defends them to the last extremity.

The lion, it is alledged, has neither the senses of smelling nor of seeing so acute as most animals of prey. The light of the sun seems to incommode him; he seldom goes abroad in the middle of the day, but makes all his excursions during the night: when he sees the fires burning around the flocks, he never approaches them. It has also been remarked, that he perceives not the odour of other animals at a distance; that he hunts by the eye only, and not by the scent, like the dog and the wolf, whose sense of smelling is finer. Even the name of *Guide*, or *Lion's Provider*, has been given to a species of lynx, which is supposed to have a piercing eye and exquisite scent; and it is said, that this lynx always follows or precedes the lion, to point out his prey. We are acquainted with this animal, which, like the lion, inhabits Arabia, Lybia, &c. and which sometimes follows the lion with a view to pick up what he leaves; for being smaller, and much weaker, he should rather fly from the lion than serve him.

The lion, when pressed with hunger, boldly attacks every animal that comes in his way. But as he is extremely formidable, and is anxiously avoided by every beast of the forest, he is often obliged to lie concealed in the paths where animals commonly pass. He lies squat on his belly among brush wood, from which he darts with such force, that he often seizes his prey at the first bound. In the deserts and forests, antelopes and monkeys are his common food, though he takes the latter when upon the ground only; for he climbs not trees like the tiger or the Puma. He devours as much at a time as will serve him two or three days. His teeth are so strong, that he breaks bones with ease, and swallows them along with the flesh. He is said to support hunger very long. As his temperament is exceedingly hot, he is impatient of thirst, and drinks as often as he finds water, which he laps like a dog. The tongue of the dog, when lapping, is bended upwards; but that of the lion is bended downward, which occasions him to drink long, and to lose much water. He requires about fifteen pounds of raw flesh every day. He prefers the flesh of living animals, especially of those whom he slays himself. He does not willingly eat putrid carcasses, and chooses rather to hunt for a fresh prey than

to use the remains of a former. Though he commonly feeds upon fresh meat, his breath is very rank, and the odour of his urine is insupportable.

The roaring of the lion is so loud, that when uttered during the night in the deserts, it resembles, by the repetition of echoes, the noise of thunder. This roaring is the ordinary voice of the lion; for when enraged, he utters a short, and suddenly repeated cry. But the roaring is a prolonged cry, a kind of a deep toned grumbling, mixed with a sharp vibrating noise. He roars five or six times in the day, and oftener before rain. When enraged, his cry is still more terrible than his roaring. He then beats his sides and the earth with his tail, agitates his mane, moves the skin of his face, and his large eyebrows, shows his dreadful tusks, and thrusts out his tongue, which is armed with prickles so hard, that it alone is sufficient to tear the skin and the flesh, without the assistance of either teeth or claws. His strength lies more in the head, jaws, and fore legs, than in the posterior parts of his body. He sees in the night, like the cats. His sleep is short, and he is easily awaked. But it is a mistaken notion, that he sleeps with his eyes open.

The ordinary pace of the lion is bold, grave, and slow, though always oblique. His course consists not of equal movements, but is performed by leaps and bounds; and his motions are so brisk, that he cannot instantly stop, but generally surpasses his aim. When he leaps on his prey, he makes a spring of twelve or fifteen feet, falls above the victim, seizes it with his fore feet, tears it in pieces with his claws, and then devours it with his teeth. While young and nimble, he lives by hunting, and seldom quits the deserts or the forests, where he finds plenty of wild animals for his subsistence. But when he grows old, heavy, and less fit for the exercise of hunting, he approaches frequented places, and becomes more dangerous to man and the domestic animals. It has indeed been remarked, that when he sees men and animals together, he attacks the latter, and never the former, unless any person strikes him; for in this case, he is wonderfully alert in distinguishing the man who hurts him; and he instantly quits his prey to take vengeance on the offender. It is alledged, that he prefers the flesh of the camel to that of all other animals. He is likewise very fond of young elephants. As they are unable to resist him till their tusks are grown, he accomplishes his purpose with ease, unless the mother come to their assistance. The elephant, the rhinoceros, the tiger, and the hippopotamus, are the only animals which can resist the fury of the lion.

This animal, however formidable, is hunted with large dogs, supported by men on horseback, who dislodge him, and make him retire. But both the dogs and the horses require to be previously trained; for most animals tremble and fly from the odour of the lion. His skin, though of a close and firm texture, resists neither a ball nor a javelin. He is seldom, however, killed with a single blow. He is often taken, as we take wolves, by making him fall into a deep pit, covered with limber materials, and upon which a live animal is fixed. The lion becomes gentle as soon as he is seized; and if advantage be taken of the first emotions of his surprize and shame, he may be chained, muzzled, and conducted at pleasure.

The flesh of the lion has a strong and disagreeable flavour; yet it is frequently eat by the Indians and Negroes. The skin, which was formerly the robe of heroes, serve these people for a mantle or a bed. They also preserve the grease, which is of a penetrating nature, and even of some use in medicine.

OF TIGERS.

TIGER being a generic name given to several animals of different species, we shall begin with distinguishing them from each other. The leopards and panthers, which are so often confounded, have both been called *Tigers* by most travellers. The ounce, a small species of panther, which is easily tamed, and used for hunting in the East, has been mistaken for the panther, and received the general denomination of *Tiger*. The lynx, and the lion's provider, by the Turks called *Karackoulah*, and by the Persians *Siyahgush*, have sometimes also received the appellation of *Panther* or of *Ounce*. All these animals are common in Africa, and in the southern regions of Asia. But the true tiger is a rare animal, little known to the ancients, and not well described by the moderns. Aristotle makes no mention of the tiger: Pliny only observes of him, that he is an animal of astonishing fleetness; and adds, that he was much more rarely to be met with than the panther, because Augustus first presented a tiger to the Romans at the dedication of the theatre of Marcellus, while Scaurus the Ædile presented 150 panthers, and afterwards Pompey exhibited 410, and Augustus 420, at the public spectacles of Rome. But Pliny gives not a single mark by which the tiger is to be distinguished: Oppian and Solinus, who wrote

after Pliny, appear to have been the first who take notice that the tiger is characterized by long stripes, and the panther by round patches. This is indeed one of the marks which distinguish the true tiger not only from the panther, but from several other animals which have been called tigers. Strabo quotes Magasthenus on the subject of the true tiger, who tells us, that in India there are tigers twice as large as the lion. Thus the only information we have from the ancients concerning this remarkable animal is that he is extremely ferocious and fleet; that his body is marked with long stripes; and that he exceeds the lion in magnitude. The moderns, as Gesner and other naturalists who mention the tiger, have added nothing to the little that had been observed by the ancients.

All those skins which have short hair and roundish and distinct spots, have been called tigers skins; and travellers, deceived by this false denomination, have indiscriminately named every ferocious animal thus spotted by the appellation of tigers. The academy of sciences were likewise misled by this prejudice; and to all the spotted animals they dissected, though very different from the genuine tiger they have given the same denomination.

The most general cause of the multiplication of equivocal and vague terms in natural history has arisen, as shall be more fully shown in the following article, from the necessity of giving names to the unknown productions of the New World. Many animals, merely from some slight resemblances to those of the Old Continent, though very different both in species and dispositions, have had the same names imposed on them. The error of calling every spotted animal a *tiger* began in Europe, and was transported to America, where it was doubly augmented. For spotted quadrupeds being discovered in this new country, they were instantly called tigers, though they neither belonged to the species of the true tiger, nor to any of those Asiatic or African animals which had falsely received that name. Hence, in place of one species of tiger, their number has been increased to nine or ten; and consequently the history of these different animals has been greatly embarrassed, what belongs to one species being often ascribed to another.

To dispel the confusion arising from these false denominations, especially among the animals which have been commonly called tigers, I shall give a comparative enumeration of quadrupeds, in which I shall distinguish, 1. Those which are peculiar to the Old World, and existed not in America upon its first discovery; 2. Those which are peculiar to the New, and were unknown in the Old World; 3. Those which are common to both continents, without being transported by men from the one to the other. For this purpose we must collect into one view what lies scattered in the works of the first historians of America.

ANIMALS PECULIAR TO THE OLD WORLD.

As the largest animals are best known, and liable to the fewest uncertainties, we shall in this enumeration trace them nearly in the order of their magnitude.

Elephants are peculiar to the Old World; the largest are produced in Asia, and the smallest in Africa. They are natives of the warmest regions; and though they are capable of existing, yet they cannot multiply in temperate climates. Even in their native country they do not propagate, after being deprived of their liberty. Though entirely confined to the warm regions of the Old Continent, their numbers are considerable. In America there is not an animal that can be compared with the elephant, either with regard to figure or magnitude.

The same remark is applicable to the rhinoceros, whose species is much less numerous than that of the elephant. He is peculiar to the deserts of Africa and to the forests of the southern regions of Asia; and no American animal has the smallest resemblance to him.

The hippopotamus inhabits the banks of the large rivers of India and Africa. His species is perhaps still less numerous than that of the rhinoceros; and he is not to be found in America nor in the temperate climates of the Old World.

The camel and dromedary, which are so common in Asia, in Arabia, and in all the eastern regions of the Old Continent, were equally unknown in America as the elephant, the rhinoceros, and the hippopotamus. The appellation of camel has been given to the lama and pacos of Peru, though these animals are so different from the camel that by some they have been called sheep, and by others camels of Peru, and though the pacos has nothing in common with our sheep but the wool, and the lama resembles the camel by the length of its neck only. The Spaniards formerly transported real camels to Peru: but the climate of this New World was not favourable to these animals; for although they produced, their numbers were never considerable.

The giraffe, or camelopard, an animal remarkable for its height, and the length of the neck and fore-legs, is not to be found in America. It is a native of Africa, particularly Ethiopia, and has never spread beyond the Tropics into the temperate regions of the Old World.

We have seen in the preceding article, that the lion exists not in America, and that the puma of Peru is an animal of a different species. We shall likewise find, that the tiger and panther are peculiar to the Ancient Continent, and that the animals of South America, which have received these names, are different species. The true tiger is a terrible animal, and perhaps more to be dreaded than the lion himself. His ferocity is tremendous; and we may judge of his strength by his size, which is commonly from four to five feet high, by nine, ten, thirteen or fourteen feet long, without comprehend-

ing the tail. His skin is not variegated with round spots, but with black bands on a yellow ground, which extend transversely over the whole body, and form rings on his tail from one end to the other. These characters are sufficient to distinguish the tiger from all the carnivorous animals of the New World, the largest of which scarcely exceed the size of our mastiffs or greyhounds. The leopard and panther of Africa and Asia are not nearly so large as the tiger, and yet they are much larger than the rapacious animals of South America. Pliny, whose testimony cannot be questioned, as panthers were in his time exposed in great numbers at the public shews of Rome, points out the essential characters of this animal, by telling us, that his hair is whitish, and every where variegated with black spots resembling eyes: he adds, that the female differs from the male in nothing but the superior whiteness of her hair. The American animals which have been called tigers have a greater similarity to the panther: from the latter, however they differ so much, that it is easy to perceive they belong not to the same species.

The first is the *jaguar*, *jaguara*, or *janowara*, and is a native of Guiana, Brasil, and other regions of South America. Ray, with some plausibility, named this animal the pard or lynx of Brasil. The Portuguese called him *once* or *anca*, because they had given that name improperly, first to the lynx, and afterwards to the small panther of India. The French, without reason, have called it a tiger; for it has no affinity to that animal. It differs also from the panther in the size of its body, the figure and situation of its spots, the colour and length of its hair, which is crisped when young, and is always rougher than that of the panther. Neither does it resemble this animal in its dispositions and manners; it is more savage, and cannot be tame. These differences however hinder not the jaguar of Brasil from resembling the panther more than any other animal of the Old World. The second we shall call *couguar*, by contracting the Brasilian name *cuguacu-ara*, pronounced by the natives *cougouacou-ara*. The French have, with still more impropriety, called this animal the red tiger. It resembles the true tiger in nothing, and differs very much from the panther, its hair being of a red colour, and without spots. The form of the head is likewise different, and the muzzle is longer than those of the tiger and panther. A third species, which has also obtained the name of tiger, and is equally removed from that species with the preceding animals, is the jaguarete. This animal is nearly of the same size with the jaguar; and resembles him in natural dispositions; but differs from him in some external characters. He has been called the black tiger, because his hair is blackish, interspersed with spots still blacker than those of the jaguar. Beside these three species, and perhaps a fourth, commonly called tigers, there is another American animal that has a greater resemblance to the tiger, namely, the mountain cat, which is related both to the cat and panther, and is more properly marked by this compound appellation than by its Mexican name *tlacoosclotl*. It is smaller than the jaguar, jaguarete, or couguar, but larger than the wild cat, which it resembles in figure, though its tail is much shorter, and its hair variegated with black spots, which are oblong on the back and circular on the belly. The jaguar, jaguarete, couguar, and mountain cat, are therefore American animals which have improperly been named tigers. We have seen the couguar and mountain cat alive, and know them to be very different in species; but they are still more different from that of the tiger and panther. With regard to the puma and jaguar, it is evident, from the descriptions of those who have seen these animals, that the puma is not a lion, nor the jaguar a tiger. Thus we may pronounce with confidence, that the lion, the tiger, and even the panther, are not to be found in America; neither are the elephant, the rhinoceros, the hippopotamus, the giraffe, nor the camel. All these species require a warm climate for the purpose of propagation; and having never inhabited northern regions, they could not convey themselves to America. This general fact is too important not to be supported by every proof that can be produced: we shall therefore continue our comparison of the animals of the Old World with those of the New.

Every man knows that horses when first transported to America struck the natives not only with surprise but with terror; and that these animals have thriven and multiplied as fast in America as in Europe. The same remark applies to the ass, from which mules have been produced that are more useful for every kind of carriage than the lama, particularly in the mountainous parts of Chili and Peru.

The zebra is an animal peculiar to the Old World, and which perhaps has never been seen in the New. It seems to be confined to a particular climate, and is found no where but in that part of Africa which extends from the Equator to the Cape of Good Hope.

Horned cattle were found neither in the islands nor on the continent of South America. Soon after the discovery of these countries, bulls and cows were transported from Europe by the Spaniards. In 1550 they for the first time laboured the ground with oxen in the valley of Cusco. These animals multiplied prodigiously on the Continent, as well as in the islands of St. Domingo, Cuba, &c.; and even became wild in several places. The species of horned cattle which we call bison, found in Mexico, Louisiana, &c. belongs not to the European race. The bison existed in America before our horned cattle were transported thither. He is so different from the latter that he may be regarded as constituting a separate species. He has a fleshy protuberance between his shoulders; his hair is softer than

wool, longer on the fore part of his body than the hind, and curled upon the neck and along the spine of the back. It is of a brown colour, obscurely marked with some whitish spots. The bison has, besides, short legs, which like the head and neck, are covered with long hair. The male has a long tail, terminating in a bush of hair, like that of the lion. Though these distinctions have appeared to me, as well as to all other naturalists, sufficient to constitute the bison and our horned cattle of different species, yet I will not presume to determine this point; because the essential characteristic of animals being of the same species is the faculty of a regular and uninterrupted propagation of their kinds; and this fact, with regard to the bison and our horned cattle, has never hitherto been subjected to the test of experiment. Mons. de la Nux, counsellor of the royal council of the island of Bourbon, has favoured me with a letter, dated 9th October 1759, in which he informs me, that the bison propagates with the common horned cattle; and it were to be wished, that persons living in these countries would imitate the example of this gentleman, in making experiments upon animals. It would be easy for the inhabitants of Louisiana to try to make the American bison copulate with the European cow, or the European bull with the female bison. Such commixtures might, perhaps, be fruitful; and in that case it would be ascertained that the European horned cattle, the bunch-backed species of the island of Bourbon, the East India bull, and American bison, constitute but one species. From the experiments of Mons. de la Nux, it is apparent, that the bunch is not an essential character, because after some generations, it entirely vanishes. Besides I have discovered that this bunch or protuberance, which appears on the camel as well as the bison, is a common, but not a permanent character, and ought to be regarded as an accidental variety, depending perhaps on the constitution of the body; for I have seen a meagre sickly camel which had no vestige of a bunch. The other character of the American bison, namely, long soft hair, appears to be a difference arising only from the influence of climate, in the same manner as we observe its effects on our goats, cats, and rabbits, when compared to those of Angora, which, though very different with regard to their hair, are nevertheless of the same species. Hence it is probable (especially if the American bison produces with European cows) that our horned cattle must formerly have passed from the northern regions contiguous to those of North America, and that having afterwards spread into the temperate regions of the New World, they assumed with time the impressions of the climate, and became real bisons. But till this essential character of generation be fully established, we must still conclude, that our cow and bull is a species peculiar to the Ancient Continent, and existed not in America till they were transported thither.

America has still less pretensions to the sheep. These animals were transported from Europe, and have succeeded both in the warm and temperate climates. But though equally prolific, they are commonly more meagre, and their flesh less succulent and tender than that of the European sheep. The climate of Brasil seems to be most favourable to them; for that is the only region of the New World where they become excessively fat. Both European and African sheep have been transported to Jamaica, and have equally succeeded. These two species belong entirely to the Old Continent.

Neither is the goat a native of America. The numerous flocks now found there have all proceeded from those which were transported. At Brasil the goat has not multiplied so fast as the sheep. When first carried to Peru by the Spaniards, goats were so rare, that they sold for 110 ducats a-piece; but they afterwards became so numerous, that they brought little more than the value of the skin. In that country, they produce three, four, and sometimes five kids at a time, while in Europe they produce one or two only. The large and small American islands are equally replenished with goats as the Continent. They have even been carried by the Spaniards to the islands of the South Sea; and in the island of Juan Fernandez, particularly, they have been extremely fertile. But as they furnished provisions to the pirates who afterwards infested these seas, the Spaniards resolved to extirpate them from the island; and for this purpose left a number of dogs, which having likewise multiplied in their turn, destroyed the goats in every accessible part of the island, and became so ferocious, that they actually attacked men.

The wild boar, the domestic hog, and the hog of China, which constitute but one species, and multiply so plentifully in Europe and Asia, are not natives of America. The Mexican hog, which has an aperture in its back, is the animal in America that approaches nearest to the common species. I have seen it alive, and have attempted in vain to make it produce with the European sow. Their characters, besides, are so different, that there is reason to pronounce them of a different species. The hogs transported from Europe to America have succeeded better, and multiplied faster, than the sheep or goat. The first swine, says Garcilasso, sold at Peru still dearer than the goats. The flesh of the ox and sheep, according to Piso, is not so good at Brasil as in Europe; but the hogs are better, and multiply faster; and Laet remarks, that those of St. Domingo have also improved so as to exceed those of Europe. In general, it is allowed, that of all domestic animals transported from Europe to America, the hog has most universally succeeded. In Canada, as well as in Brasil, which includes

the coldest and warmest climates of the New World, the hogs produce and multiply, and their flesh is equally good. The goat, on the contrary, has multiplied in the warm or temperate countries only, and cannot maintain the species in Canada: it is for this reason, that though numbers of them are brought from Europe, they still continue to be rare in that country. The ass, which multiplies in Brasil, Peru, &c. is unable to multiply in Canada, where neither mules nor asses, though many couples of the latter have been from time to time transported thither, are to be seen. The cold seems to deprive them of that vigour of constitution, that natural ardour, by which in warm climates they are so much distinguished from other animals. Horses have multiplied nearly in an equal manner over all the regions of America. They appear to have diminished in size only. But that is common to them with all the other animals brought from Europe to America; for in Canada, the ox, the goat, the sheep, the hog, the dog, are smaller than in France; and what is still more singular, all the native American animals are in general much smaller than those of the Old Continent. In this New World, Nature seems to have operated upon a smaller scale: Man alone has been copied after the same model. But before mentioning the facts which support this observation, we must finish our enumeration.

The hog, as we have seen, is not a native of America, but was transported thither; and he has not only multiplied there in a domestic state, but has become wild in many places, where he multiplies in the woods, like our wild boars, without the aid of man. A species of hogs, different from those of Europe, have likewise been transported from Guinea to Brasil, where they have increased. This Guinea hog, which is smaller than the European kind, has long pointed ears, and a tail that almost trails on the ground. It is not covered with bristles, but with short hair, and appears to be a distinct species from that of Europe; for we have never learned from Brasil, where the ardour of the climate favours every kind of propagation, that the two species have intermixed, or even produced mules.

The dog, whose races are so various, and so universally diffused, appears not in America but by a kind of specimens, which it is difficult to compare with the whole species. At St. Domingo, there were small animals called *gosques*, which resembled little dogs. But Garcilasso affirms, that they had no dogs similar to those of Europe. He adds, that the European dogs, which had been transported to Cuba and St. Domingo, and became wild, had diminished the number of cattle, which had also become wild; and that these dogs hunt in packs of ten or twelve, and are equally destructive as the wolves. There are no genuine dogs, says Joseph Acosta, in the West Indies, but only animals resembling small dogs, called *alcos* in Peru, and which attached themselves to their masters, and had nearly the same dispositions with the dog. If Father Charlevoix merits credit, who quotes no authority, 'the *goschis* of St. Domingo were small 'dumb dogs, which served for the amusement of the 'ladies. They were also used for hunting other animals 'by the scent. They made excellent eating, and were 'a great supply to the Spaniards when the first famines 'happened; so that if great numbers had not afterwards 'been brought from the continent, the species would 'have been exhausted. There were several kinds of 'them; the hair of some was smooth and shining; 'others had their bodies covered with very soft wool; 'and the greatest number had only a kind of tender thin 'down. The varieties in their colour surpassed even 'those of our dogs.'

If ever this species of *goschis* existed, with the qualities ascribed to it by Father Charlevoix, why has it been passed over in silence by other authors? And why do not these animals, which, according to him, were not only spread over the island of St. Domingo, but several places of the Continent, no longer subsist? Or if they do subsist, why have they lost all their beautiful peculiarities? It is probable that the *goschis* of Charlevoix, whose name he never met with but in the writings of Father Pers, is the *gosques* of Garcilasso. Perhaps, likewise, the *gosques* of St. Domingo, and the alco of Peru, are the same animal; and it seems to be certain, that this animal is more allied to the European dog, than any other American quadruped. Some authors have regarded it as the genuine dog. Jean Laet says, in express terms, that upon the discovery of the West Indies, they employed for hunting a kind of small dogs, which were absolutely mute. It was remarked, in the history of the dog, that in warm climates he loses the faculty of barking. But this loss is supplied by a sort of howling; and they are never, like these American animals, perfectly mute. Dogs transported from Europe have thriven almost equally well in the hottest and coldest climates of America, and they are more esteemed by the savages than any other animal. In warm countries, they have lost their voice; in cold regions, their size is diminished; and almost every where their ears have become erect. Hence they have degenerated, or rather mounted up to their primitive race, which is that of the shepherd's dog, which has erect ears, and barks less than any other kind. Dogs may therefore be regarded as belonging solely to the Old Continent, where their nature and talents are unfolded in the temperate regions only, and where they seem to have been variegated and brought to perfection by the care of man; for in all uncivilized and very hot, or very cold countries, they are equally small, ugly, and almost mute.

The hyæna, which is of the size of the wolf, was known to the ancients. It is remarkable for an orifice and glands, situated as in the badger, between the anus

and tail, from which proceeds a strong fœtid odour. He is likewise remarkable for his strong mane, which runs along the neck and shoulders, and for an enormous voracity, which incites him to dig up bodies from the graves, and devour the most putrid flesh. This horrible creature is found in Arabia only, and other southern provinces of Asia. It exists not either in Europe or in the New World.

The jackall, which of all animals makes the nearest approach to the dog, though he differs in essential characters, is very common in Armenia and Turkey, and is likewise found in several other provinces of Asia and Africa: but he is an absolute stranger to America. He is remarkable for the colour of his hair, which is a brilliant yellow: he is about the size of a fox; and though the species is very numerous, it has never reached Europe nor even the north of Asia.

The genet, which is a native of Spain, would never have passed undiscovered if it had existed in the New World. But as no American historians or travellers make any mention of him, he must be considered as peculiar to the Old Continent. He inhabits the southern parts of Europe, and those of Asia under the same latitude.

Though the civet has been said to be found in New Spain; yet it seems not to be the civet of Africa and the Indies from which we derive the musk, and which is mixed and prepared with that of the animal called *hiam* in China; for we consider the true civet to be an animal peculiar to the southern regions of the Old Continent, which has never reached the northern provinces, and could not pass over to the New.

Cats as well as dogs were entire strangers to America; and though it appears that a person in the train of Christopher Columbus killed a wild cat in these new regions; yet I am persuaded that these animals had then no existence there. I was not at that time equally skilled in the many abuses made of names; and I acknowledge, that I am not yet so well acquainted with animals as to distinguish them clearly in the false or misapplied appellations given them by travellers. Neither is this surprising, since our nomenclators, whose researches have been entirely directed to this point of view, instead of throwing light upon the subject, have increased the confusion by other names and phrases adapted to their arbitrary arrangements, which are always more deceitful than actual inspection. The natural propensity of comparing objects which we see for the first time to those already known, joined to the almost insuperable difficulty of pronouncing American names, are the two causes of this misapplication of terms, which has been productive of so many errors. It is easier, for example, to call a new animal *a wild boar* or *a black hog*, than to pronounce his American name, *quauh-coyamelt*; to call another an *American fox*, than to preserve his Brasilian name *tamandua-guaca*; to call those animals *Peruvian sheep or camels*, which, in the language of the natives, are denominated *pelou jehialt-oquitli*. In the same manner the *cabiai*, *cabionara*, or *capybara*, is called the *water-hog*, though it be an animal very different from the hog; and the *carigueibeju* is called *an otter*. The same confusion has been introduced into almost all the animals of the New World, whose names were so strange and barbarous to the Europeans that they endeavoured to bestow others upon them derived from resemblances, sometimes happily imagined, with the animals of the Old Continent, but often borrowed from relations too remote to justify such denominations. Five or six species of small animals were regarded as hares, for no other reason but because, like the latter their flesh was very good. An animal without horns was called *a cow* or *an elk*, which the Americans denominated *tapiierete* at Brasil, *manipouris* at Guiana, and it was called *anta* by the Portuguese, though it had no other relation to the cow or elk than a slight resemblance in the form of the body. Some others compared the *pak* or *paca* to the rabbit, and others to a hog of two months old: some considered the *oppossum* as a rat, and called it *the wood-rat*; and others took it for a small *fox*. But it is unnecessary here to expose at greater length the false denominations bestowed by travellers, historians, and nomenclators, upon the American animals; because I shall endeavour in a subsequent part of this discourse to point them out and to correct them.

We have seen, that all our domestic animals, and the largest species of the wild animals of Africa and Asia, had no original existence in the New World. Several species likewise, of less consideration, belong not to America, which we shall enumerate as succinctly as possible.

The antelopes, whose species are numerous, and of which some inhabit Arabia, others Africa, and others the East Indies, require a warm climate for subsisting and multiplying. They never stretched into the northern parts of Europe so as to enable them to pass over to America. Hence these African and Asiatic species were not found in the New World. The Barbary antelope seems indeed to have been transported thither, and Hernandes calls it *algazel ex Aphrica*. The animal of New Spain called by the same author *temamacame*, by Seba *cervus*, by Klein *tragulus*, and by Brisson *the antelope of New Spain*, appears to be a different species from all the antelopes of the Old Continent.

It is natural to imagine, that the chamois goat, which delights in the Alpine snows, would not avoid the frozen regions of the north, and might therefore have passed over to America; yet it is not to be found there. This animal seems not to affect a peculiar climate but a particular situation. He is fond of the summits of the Alps, Pyrennees, &c.; and instead of spreading farther,

he has never descended to the plains at the foot of those mountains. This is not the only animal which dwells perpetually in the same climate and situation. The marmot, the wild goat, the bear, and the lynx, are also mountain animals, and rarely appear in the plains.

The buffalo, which is a native of warm climates, and has been rendered domestic in Italy, resembles the American bison less than the ox, and is not found in the New Continent.

The wild goat inhabits the tops of the highest mountains of Europe and Asia; but was never seen on the Cordeliers.

The musk animal, which is nearly of the size of a fallow deer, inhabits only particular provinces of China, and of the eastern parts of Tartary. The royal antelope, known by the name of the small stag of Guinea, appears to be confined to certain provinces of Africa, the East Indies, &c.

The rabbit, which came originally from Spain, and is now diffused over all the temperate climates of Europe, existed not in America; for the animals called by that name belong to a different species; and all the genuine rabbits in America were transported thither from Europe.

The ferrets, which were brought from Africa into Europe, where they cannot subsist without the care of man, were not found in America. Even our rats and mice were unknown in that continent. But they were transported in our ships, and are now prodigiously numerous in all the cultivated countries of the New World.

The following is a pretty exact list of the animals peculiar to the Old Continent, and which had no existence in America previous to its intercourse with Europe: the elephant, the rhinoceros, the hippopotamus, the camelopard, the camel, the dromedary, the lion, the tiger, the panther, the horse, the ass, the zebra, the ox, the buffalo, the sheep, the goat, the hog, the dog, the hyæna, the jackall, the genet, the civet, the cat, the antelope, the chamois goat, the wild goat, the small Guinea stag, the rabbit, the ferret, the rat, the mouse, the fat squirrel, the garden squirrel, the marmot, the ichneumon, the badger, the sable, the stoat or ermine, the jerboa, the maki, and several species of monkeys, &c. All these animals are peculiar to the Old Continent, as shall be shown when we give the history of each.

OF ANIMALS PECULIAR TO THE NEW WORLD.

The animals of the New World were equally unknown to the Europeans as ours were to the natives of America. In the New Continent the only half-civilized people were the Peruvians and Mexicans. The latter had no domestic animals; but the former had reduced to slavery the lama, the pacos, and the alco, a small creature resembling a little dog. The pacos and the lama, to which Fernandes gives the name of *peruichcatl*, or *Peruvian cattle*, like the chamois goat, frequent the highest mountains only, as those of Peru, Chili, and New Spain. Though they had become domestic in Peru, and of course had been spread over the adjacent countries; yet instead of multiplying in the place of their nativity, their number has diminished since the European cattle, which have succeeded wonderfully in all the southern regions of America, were transported thither.

It is singular, that in a world almost totally occupied by savages, whose manners approached to those of the brute creation, there should have been no society or correspondence between these savage men and the animals which surrounded them; for no domestic animals appear without some degree of civilization. Does it not follow, that man in the savage state is only a species of animal incapable of governing others, and possessing nothing but his individual faculties, employs them for procuring subsistence, and providing for his safety, by attacking the weak and avoiding the strong animals, without any desire of reducing them to subordination? In every nation, though half-civilized only, we meet with domestic animals. In France, the horse, the ass, the ox, the sheep, the goat, the hog, the dog, and the cat; in Italy, the buffalo; in Lapland, the rein-deer; in Peru, the lama, the pacos, and the alco; in the eastern countries, the dromedary, the camel, other species of the ox, the sheep, and the goat; in the southern regions, the elephant; all these have been reduced to servitude, or rather admitted into society; while the savage, who hardly wishes for the society of his female, either fears or disdains that of other animals. It is true, none of the species we have rendered domestic existed in America. But if the savages with whom it was peopled had anciently united and diffused the mutual knowledge and resources of society, they would have subjugated almost all the animals of that country, most of them being of gentle, tractable, and timid dispositions, very few ferocious, and none formidable. Hence these animals have avoided the slavery of a domestic state neither by the fierceness of their nature, nor by the indocility of their dispositions. Their liberty has resulted solely from the weakness of man, whose powers are extremely circumscribed without the aid of society, upon which even the multiplication of his species depends. The immense territories of the New World contained not upon its first discovery a greater number of inhabitants than what are to be found in one half of Europe. This scarcity of the human species allowed the other animals to multiply prodigiously. They had fewer enemies and more space: every circumstance was favourable to their increase; and each species accordingly consisted of a vast number of individuals. But the number of the species, when compared with those of the Old

Continent was not above one fourth or one third. If we reckon that 200 species of quadrupeds exist in the whole known quarters of the globe, we shall find above 130 of them in the Old Continent, and less than 70 in the New; and if we substract the species common to both Continents, or those which by their constitution were able to endure the rigours of the north, and passed by land from the one Continent to the other, the New World cannot claim above 40 native species. In America, therefore, animated Nature is weaker, less active, and more circumscribed in the variety of her productions; for we perceive from the enumeration of the American animals, that the number of species is not only fewer, but in general, that all the animals are much smaller than those of the Old Continent. No American animal can be compared with the elephant, the rhinoceros, the hippopotamus, the dromedary, the camelopard, the buffalo, the lion, the tiger, &c. The tapir or *tapiierete* of Brasil, is the largest quadruped of South America. This animal, the elephant of the New World, exceeds not the size of a calf of six months old, or of a very small mule; for he has been compared to both of these animals, though he has no resemblance to either, having neither a whole nor a cloven hoof, but feet irregularly digitated, namely, four toes on the fore feet, and three on the hind feet. His body is shaped nearly like that of the hog. His head, however, is proportionally much larger: he has no tusks or canine teeth; and the upper lip is very long and moveable at pleasure. The lama is not so large as the tapir, and he appears to be large only by the length of his neck and legs. The pacos is still a much smaller animal.

The cabiai, which, next to the tapir, is the largest animal of South America, exceeds not the size of an ordinary hog. He differs as much as any of the former from all the animals of the Old Continent; for though he has been called the *marsh* or *river hog*, he differs from that animal by conspicuous and essential characters. He is digitated, having, like the tapir, four toes on the fore feet and three on the hind feet. His eyes are large, his mnzzle gross and obtuse, his ears small, his hair short, and he has no tail.

The tajacou is smaller than the cabiai, and has a greater resemblance to the hog, from which he differs greatly in the structure of his internal parts, as in the form of the stomach and lungs, &c. He has also an open gland on the lower part of his back, which discharges a fœtid liquor. He is therefore a species different from that of the hog; and neither the tajacou, the cabiai, nor the tapir, are found in any part of the Old Continent. The same thing may be said of the *tamandua-guacu* or *ouariri*, and of the *ouatiriou*, which we have called *ant-eaters*. These animals, the largest of which is below mediocrity, seem to be peculiar to South America. Their structure is very singular; they have no teeth; their tongue is long and cylindrical, like that of the birds called woodpeckers; the opening of the mouth is so small, that they can neither bite nor hardly lay hold of any thing; but extend their long tongue, and putting it in the way of the ants, retract it when loaded with these insects, which is the only method they have of procuring nourishment.

The sloth, which the natives of Brasil call *ai* or *hai*, on account of the plaintive cry *ai*, which it perpetually utters, seems likewise to be peculiar to the New Continent. He is still smaller than any of the former, being only about two feet long. He is remarkable for walking slower than the turtle, for having three toes both on the fore and hind feet, the fore legs much longer than the hind ones, a very short tail, and no external ears. Besides, the sloth and the armadillo are the only quadrupeds which have no cutting and canine teeth, but cylindrical grinders only, which are rounded at the extremities, nearly like those of some of the cetaceous animals.

The cariacou of Guiana is an animal of the nature and size of our largest roebucks. The male has horns which fall off annually, and the female has none. At Cayenne he is called the *wood-hind*. There is another species, called the *little cariacou*, or *marsh-hind*, which is considerably smaller than the former, and the male has no horns. From the resemblance of the name, I suspected that the cariacou of Cayenne might be the *cuguacu*, or *cougouacou-apara* of Brasil; and having compared the descriptions given by Piso and Marcgrave of the cougouacou, with the characters of the cariacou, which I had alive, it appeared to be the same animal, but at the same time, so different from our roebuck, that it ought to be regarded as a distinct species.

The tapir, the cabiai, the tajacou, the ant-eater, the sloth, the cariacou, the lama, the pacos, the bison, the puma, the jaguar, the couguar, the juguarete, the mountain-cat, &c. are the largest animals of the New Continent. The middle sized and smaller kinds are the gouandous, or cuandus, the agoutis, the coatis, the pacos, the opossum, the Indian hogs, the cavies, and the armadillos, which I believe are all peculiar to America, though our latest nomenclators mention a species of armadillo in the East Indies, and another in Africa. For the existence of these, we have only the testimony of the describer of the cabinet of Seba, which is not an authority that merits credit; for errors arising from the names of countries are very common in collections of natural objects. An animal is purchased under the name of the *ternate*, or *American bat*, another under that of the *East India armadillo*. They are immediately announced under these appellations in the description of this collection, and are adopted into the lists of our nomenclators. But when examined more closely, these Ternate, or American bats, are found to be French bats

and the Indian or African armadillos may likewise belong to America.

We have not hitherto mentioned the ape tribes, because their history demands a particular discussion. The word *ape* is a generic name applied to a great number of species; it is not therefore surprising, that many of them are said to be found in the southern regions of both Continents. But we must now inquire whether the apes of Asia and Africa are the same with the American animals to which that name has been applied, and whether out of more than thirty species, which we have examined alive, there be a single one of them common to both Continents.

The satyr, or man of the wood, whose figure differs less from that of a man than of an ape, is peculiar to Africa and the south of Asia, and exists not in America.

The gibbon, whose fore legs, or hands, are as long as the whole body including the hind legs, is found in the East Indies, but not in America. These two apes have no tails.

The ape, properly so called, whose hair is of a greenish colour, mixed with a little yellow, and has no tail, is a native of Africa, and some other parts of the Old Continent, but not of the New. The same thing may be said of the *cynocephali*, or dog-headed apes, of which there are two or three species. Their muzzle is not so short as that of the former; but they have no tail, or it is so short as scarcely to be visible. All the apes which have no tail, particularly those with short muzzles, and whose face of course greatly resembles that of man, are the genuine apes; and the five or six species we have mentioned are all natives of the warm climates of the Old Continent, and are found in no part of the New. Hence we are authorized to affirm, that there are no true apes in America.

The baboon, an animal larger than a dog, and whose body is contracted like that of the hyæna, is very different from the apes formerly mentioned. His tail is very short, and always erect; his muzzle is long, and broad at the extremity; his buttocks are naked, and of a blood colour; his legs are very short, and his nails strong and sharp. This animal, which has great strength, and is very mischievous, is found only in the southern deserts of the Old Continent, and not in America.

Hence all the apes which have no tails, and all those whose tails are remarkably short, belong solely to the Old Continent; and of those with long tails, almost all the large kinds are found in Africa. There are a few of a middle size in America; but the animals, called *little monkeys with long tails*, are very numerous in the New World. These little monkeys, are the *sapajous*, the *sagouins*, the tamarins, &c. When we give the particular history of these animals, it shall be shown that all the American monkeys are different from those of Africa and Asia.

The makis, of which we know three or four species, or varieties, make a near approach to the monkeys with long tails, having, like them, hands, but longer and sharper muzzles, and are also peculiar to the Old Continent. Thus all the animals of Africa and the south of Asia, which have received the names of *apes* or *monkeys*, are not to be found in America, any more than the elephant, rhinoceros, or tiger.

The more minutely we inquire into this subject, we will be the more convinced that the animals of the southern regions of the one Continent existed not in the other, and that the few which are now found there, were transported by man, as the Guinea sheep, which has been carried to Brasil; the Guinea pig, which was brought from Brasil into Guinea, and perhaps, some other small animals, the transportation of which was facilitated by the commerce and small distance of these two parts of the globe. Between the coast of Guinea and that of Brasil, there are about 500 leagues of sea; and there are more than 2000 between the coast of Peru and the East Indies. All those animals which from their nature cannot endure cold climates, and even those which, though they could subsist, cannot produce in such climates, are confined on two or three sides, by seas which they are unable to traverse, and on the other by countries so cold, that they cannot live in them. Hence we ought not to wonder at this general fact, which at first appeared singular, and was never before so much as suspected, namely, that none of the animals which are natives of the Torrid Zone of the one Continent, are to be found in the other.

OF ANIMALS COMMON TO BOTH CONTINENTS.

From the preceding enumeration, it appears that not only the quadrupeds in the warmest climates of Africa and Asia, but most of those in the temperate regions of Europe, are wanting in America. But several of our animals which can endure cold, and multiply in the northern climates, are found in North America: and though they differ considerably, we are obliged to acknowledge them to be the same, and to believe that they formerly passed from the one Continent to the other by lands, which are still unknown, or rather have long since been swallowed up by the ocean. This proof, drawn from Natural History, is a stronger demonstration of the almost continued contiguity of these two Continents, than all the conjectures of speculative geographers.

The bears of the Illionois, of Louisiana, &c. appear to be the same with ours; only the former are smaller and blacker.

The stag of Canada though less than ours, differs

from him only by the greater height of his horns, more numerous antlers, and a longer tail.

The roebuck, which is found in the south of Canada and in Louisiana, is likewise smaller, and has a longer tail than the European kind. The original is the same animal with the elk, though it is not equally large.

The rein-deer of Lapland, the fallow-deer of Greenland, and the caribou of Canada appear to be the same animal. The fallow-deer or stag of Greenland, described and painted by Edwards, has too great a resemblance to the rein-deer to be regarded as a different species. As to the caribou, though there is no exact description of it; yet from the marks we have been able to collect, it seems to be the same animal with the rein-deer. M. Brisson has made the caribou a different species, and refers it to the *cervus Burgundicus* of Johnston. But this *cervus Burgundicus* is an unknown animal, and certainly never existed either in Burgundy or in Europe: it is a simple name that has been given to some uncommon horns of the stag or fallow-deer; or rather M. Brisson may have seen the head of the caribou, whose horns consisted of one straight stem on each side, about ten inches long, with an antler or branch near the base, turned forwards; or the head of a female rein-deer; or a head of the first or second year; for the female rein-deer bears horns as well as the male, though much smaller, and in both, the direction of the first antlers is forward; and lastly, in this animal, as well as in all others of the deer kind, the ramifications of the horns are exactly proportioned to the number of years they have lived.

The hares, the squirrels, the hedgehogs, the otters, the marmots, the rats, the shrew-mice, and the moles, are also species common to the two Continents, though in all these kinds there is not an American species perfectly similar to those of Europe; and it is extremely difficult, if not impossible, to pronounce with certainty whether they are really different species, or only varieties of the same, changed by the influence of the climate.

The beavers of Europe appear to be the same with those of Canada. Though these animals prefer cold countries, they can subsist, and even multiply in temperate climates. There are still some of them in France upon the islands of the Rhone. Their number was formerly much greater; and they seem to avoid populous countries more than very warm climates. They never establish their societies but in deserts remote from the habitations of men: and even in Canada, which may be considered as a vast desert, they have retired far from any of our settlements.

The wolf and fox are also common to both continents. They are found, but with some varieties, in all parts of North America, where there are black foxes and wolves; but all of them are smaller than those of Europe, which is the case with every animal, whether native or transported.

Though the weasel and ermine frequent the cold countries of Europe, they are at least very rare in America; but the pine-weasel, the martin, and the polecat, are more numerous.

The pine-weasel of North America appears to be the same with ours. The vison, or pekan weasel of Canada, has a great resemblance to the martin; and the striped polecat of North America is perhaps only a variety of the European kind.

The American lynx seems to be the same with the European. He prefers cold countries; but he likewise lives and multiplies in temperate climates, and generally frequents the forests and high mountains.

The seal, or sea-calf, seems to be confined to northern countries, and is found equally on the coasts of Europe and of North America.

These are nearly all the animals which are common to the Old and New Worlds; and from this number, which is not considerable, we ought, perhaps, to retrench more than a third part, whose species, though apparently the same, may be different in reality. But admitting the identity of all these species with those of Europe, the number common to the two continents is very small, when compared with that of the species peculiar to each. It is farther apparent, that of all these animals, it is those only which frequent the northern countries that are common to both Continents; and that none of those which cannot multiply but in warm or temperate climates are found in both worlds.

It is therefore no longer a doubtful point, that the two Continents either are, or have formerly been, contiguous towards the north, and that the animals common to both have passed from the one to the other by lands with which we have now no acquaintance. We are led to believe, especially since the discoveries made by the Russians to the north of Kamtschatka, that the lands of Asia are contiguous to those of America; for the north of Europe seems to have been always separated from the New World by seas too considerable to permit the passage of any quadruped. These animals, however, of North America, are not precisely the same with those of the north of Asia; but have a stronger resemblance to the quadrupeds of the north of Europe. It is the same with the animals which belong to the temperate climates. The argali, or Siberian goat, the sable, the Siberian mole, and the Chinese Musk, appear not in Hudson's Bay, nor in any other north west part of the New Continent; but on the contrary, we find in the north east parts of it, not only the animals common to the north of Europe and Asia, but likewise those which appear to be peculiar to Europe, as the elk, the rein-deer, &c. It must, however, be acknowledged, that the north east parts of Asia are so little known, that we can have no certainty whether the animals of the north of Europe exist there or not.

We formerly remarked, as a singular phænomenon, that the animals in the southern provinces of the New Continent, are small in proportion to those in the warm regions of the Old. There is no comparison between the size of the elephant, the rhinoceros, the hippopotamus, the camelopard, the camel, the lion, the tiger, &c. and the tapir, the cabiai, the ant-eater, the lama, the puma, the jaguar, &c. which are the largest quadrupeds of the New World: the former are four, six, eight, and ten times larger than the latter. Another observation brings additional strength to this general fact: all the animals which have been transported from Europe to America, as the horse, the ass, the ox, the sheep, the goat, the hog, the dog, &c. have become smaller; and those which were not transported, but went thither spontaneously, those, in a word, which are common to both Continents, as the wolf, the fox, the stag, the roebuck, the elk, &c. are also considerably less than those of Europe.

In this New World, therefore, there is some combination of elements and other physical causes, something that opposes the amplification of animated Nature: there are obstacles to the developement, and perhaps to the formation of large germs. Even those which, from the kindly influences of another climate, have acquired their complete form and expansion, shrink and diminish under a niggardly sky and an unprolific land, thinly peopled with wandering savages, who, instead of using this territory as a master, had no property or empire; and having subjected neither the animals nor the elements, nor conquered the seas, nor directed the motions of rivers, nor cultivated the earth, held only the first rank among animated beings, and existed as creatures of no consideration in Nature, a kind of weak automatons, incapable of improving or seconding her intentions. She treated them rather like a stepmother than a parent, by denying them the invigorating sentiment of love, and the strong desire of multiplying their species. For though the American savage be nearly of the same stature with men in polished societies; yet this is not a sufficient exception to the general contraction of animated Nature throughout the whole Continent. In the savage, the organs of generation are small and feeble. He has no hair, no beard, no ardour for the female. Though nimbler than the European, because more accustomed to running, his strength is not so great. His sensations are less acute; and yet he is more timid and cowardly. He has no vivacity, no activity of mind. The activity of the body is not so much an exercise or spontaneous motion, as a necessary action produced by want. Destroy his appetite for victuals and drink, and you will at once annihilate the active principle of all his movements; he remains in stupid repose on his limbs or couch for whole days. It is easy to discover the cause of the scattered life of savages, and of their estrangement from society. They have been refused the most precious spark of Nature's fire. They have no ardour for women, and of course no love to mankind. Unacquainted with the most lively and most tender of all attachments, their other sensations of this nature are cold and languid. Their love to parents and children is extremely weak. The bonds of the most intimate of all societies, that of the same family, are feeble; and one family has no attachment to another. Hence no union, no republic, no social state, can take place among them. The physical cause of love gives rise to the morality of their manners. Their heart is frozen, their society cold, and their empire cruel. They regard their females as servants destined to labour, or as beasts of burden, whom they load unmercifully with the produce of their hunting, and oblige, without pity or gratitude, to perform labours which often exceed their strength. They have few children, and pay little attention to them. Every thing must be referred to the first cause: they are indifferent, because they are weak; and this indifference to the sex is the original stain which disgraces Nature, prevents her from expanding, and by destroying the germs of life, cuts the root of society.

Hence man makes no exception to what has been advanced. Nature, by denying him the faculty of love, has abused and contracted him more than any other animal. But before examining the causes of this general effect, it must be allowed, that if Nature has diminished all the quadrupeds in the New World, she seems to have cherished the reptile and enlarged the insect tribes; for though at Senegal there are longer serpents and larger lizards than in South America, yet the difference between these animals is not near so great as that which subsists between the quadrupeds. The largest serpent of Senegal is not double the size of the Cayenne serpent. But the elephant is perhaps ten times the bulk of the tapir, which is the largest quadruped of South America. With regard, however, to insects, they are no where so large as in South America. The largest spiders, beetles, caterpillars, and butterflies, are found in Cayenne and other neighbouring provinces: here almost all insects exceed those of the Old Word, not in size only, but in richness of colouring, delicacy of shades, variety of forms, number of species, and the prodigious multiplication of individuals. The toads, the frogs, and other animals of this kind, are likewise very large in America. We shall take no notice of birds and fishes; because as Nature has enabled them to pass from the one Continent to the other, it is hardly possible to distinguish those which are proper to each. But reptiles and insects, like the quadrupeds, are confined to their respective Continents.

Let us now examine why the reptiles and insects are so large, the quadrupeds so small, and the men so cold, in the New World. These effects must be referred to the quality of the earth and atmosphere, to the degree

of heat and moisture, to the situation and height of mountains, to the quantity of running and stagnant waters, to the extent of forests, and above all to the inert condition of nature in that country. In this part of the globe the heat in general is much less and the humidity much greater. If we compare the heat and cold of every degree of latitude, we shall find very considerable differences: at Quebec, for example, which is under the same degree of latitude with Paris, the rivers freeze every year some feet thick; a coat of snow still thicker covers the land for several months; the air is so cold that the birds fly off and disappear during the winter, &c. This difference of heat, under the same latitude in the Temperate Zone, though very considerable, is perhaps still less than the difference of heat under the Torrid Zone. In Senegal the sun is perfectly scorching; while in Peru, which lies under the same line, an agreeable temperature prevails. The same remark applies to all the other latitudes. The Continent of America is so formed and situated that every circumstance concurs in diminishing the action of heat. America contains the highest mountains, and of course the largest rivers of the world. These mountains form a chain which seems to bound the Continent towards the west through its whole extent. The plains and low grounds are all situated on this side of the mountains, and run from their bottoms to the sea which separates the Continents on this side. Thus the east wind, which blows perpetually between the Tropics, arrives not in America till it has traversed a vast ocean, by which it is greatly cooled. Hence this wind is much cooler in Brasil, Cayenne, &c. than in Senegal, Guinea, &c. where it arrives impregnated with the accumulated heat acquired from all the lands and burning sands in its passage through Asia and Africa. Let us recollect what was remarked concerning the different colours of men, and particularly of the Negroes. It seemed to be demonstrated, that the greater or less degree of a tawny, brown, or black colour, depends entirely on the situation of the climate; that the Negroes of Nigritia, and those of the west coast of Africa, are blackest; because their countries are situated in such a manner that the heat is always greater than in any other part of the globe, the east wind before its arrival having traversed vast tracts of land; that on the contrary, the American Indians under the line are only tawny, and the Brasilians brown, though under the same latitude with the Negroes; because the heat of their climate is neither so great nor so constant, the east wind arriving not till after being cooled by the waters, and loaded with moist vapours. The clouds which intercept the light and heat of the sun, and the rains which refresh the air and the surface of the earth are periodic, and continue several months in Cayenne and other regions of South America. This first cause renders all the east coasts of America much more temperate than Africa or Asia: and after the east wind has arrived in a cool state, in traversing the plains of America, it begins to assume a greater degree of heat, when it is suddenly stopped and cooled by that enormous chain of mountains of which the western part of the New Continent is composed; so that it is still colder under the line at Peru, than at Brasil, Cayenne, &c. on account of the prodigious elevation of the land. Hence the natives of Peru, Chili, &c. are less brown, red, or tawny, than those of Brasil. If these mountains were reduced to a level with the adjacent plains, the heat on the western coasts would become excessive, and we would soon find negroes at Peru and Chili as well as upon the west coast of Africa.

Thus from the situation of the land alone in the New Continent, the heat must be greatly inferior to that of the Old; and I shall now show that there is likewise a greater degree of moisture in America. The mountains, which are the highest upon the globe, and are opposed to the direction of the east wind, stop and condense all the ærial vapours, and of course give rise to an infinite number of springs, which, by uniting, soon form the greatest rivers in the world. Hence in the New Continent there are more running waters in proportion to the extent of territory than in the Old; and this quantity of water is greatly increased for want of proper drains or outlets. The natives having neither stopped the torrents, nor directed the rivers, nor drained the marshes, the stagnating waters cover immense tracts of land, augment the moisture of the air and diminish its heat. Besides, as the earth is every where covered with trees, shrubs, and gross herbage, it never dries. The transpiration of so many vegetables pressed close together produce immense quantities of moist and noxious exhalations. In these melancholy regions nature remains concealed under her old garments, and never exhibits herself in fresh attire; being neither cherished nor cultivated by man, she never opens her fruitful and beneficent womb. Here the earth never saw her surface adorned with those rich crops which demonstrate her fecundity, and constitute the opulence of polished nations. In this abandoned condition every thing languishes, corrupts, and proves abortive. The air and the earth, overloaded with humid and noxious vapours, are unable either to purify themselves, or to profit by the influences of the sun, who darts in vain his most enlivening rays upon this frigid mass, which is not in a condition to make suitable returns to his ardour. Its powers are limited to the production of moist plants, reptiles, and insects, and can afford nourishment only to cold men and feeble animals.

The scarcity of men therefore in America, and most of them living like the brutes, is the chief cause why the

earth remains in a frigid state, and is incapable of producing the active principles of nature. To expand the germs of the largest quadrupeds, and to enable them to grow and multiply, requires all the activity which the sun can give to a fertile earth. It is for the opposite reason, that insects, reptiles, and all the animals which wallow in the mire, whose blood is watery, and which multiply in corruption, are larger and more numerous in the low, moist, and marshy lands of the New Continent.

When we reflect on these remarkable differences between the Old and New World, we are inclined to believe that the latter is actually more recent, and has continued longer than the rest of the globe under the waters of the ocean; for if we except the enormous western mountains, which appear to be mounuments of the highest antiquity which this globe affords, all the low parts of this continent seem to be new lands, elevated and formed by the sediments of waters. In many places, immediately under the vegetable stratum, we find sea shells and madrepores already forming large masses of lime-stone, but which are commonly softer than our free-stone. If this continent be really as ancient as the other, why was it so thinly peopled? Why were almost the whole of its inhabitants wandering savages? Why did the Peruvians and Mexicans, who had united into society, reckon only two or three hundred years since the existence of the first man who taught them to associate? Why are they still ignorant of the art of transmitting facts to posterity by permanent signs, since they had already discovered a method of conveying their ideas at a distance by tying knots upon cords? Why did they not reduce the lama, the pacos, and other animals, into a domestic state? Their arts, like their society, were in embryo; their talents were imperfect, their ideas locked up, their organs rude, and their language barbarous.

Hence every circumstance indicates that the Americans are new men, or rather men who had been so long separated from their original country that they had lost every idea of the part of the world from which they had issued; that the greatest part of the continent of America was new land, still untouched by the hand of man, and in which nature had not time sufficient to accomplish her plans, or to unfold the whole extent of her productions; that the men are cold, and the animals small, because the ardour of the former, and the magnitude of the latter, depend upon the salubrity and heat of the air; and that some centuries hence, when the lands are cultivated, the forests cut down, the courses of the rivers properly directed, and the marshes drained, this same country will become the most fertile, the most wholesome, and the richest in the whole world, as it is already in all the parts which have experienced the industry and skill of man. We mean not, however, to conclude, that large animals would then be produced. The tapir and cabiai will never acquire the magnitude of the elephant or hippopotamus. But the animals transported thither will no longer diminish, as they have formerly done. Man will gradually fill up the vacuities in these immense territories, which were perfect deserts when first discovered.

The first historians of the Spanish conquest, to augment the glory of their arms, have exaggerated prodigiously the number of the enemies they had to encounter. Can these historians persuade any man of sense that there were millions of inhabitants in Cuba and St. Domingo, when at the same time there was neither a monarchy, a republic, nor hardly any society among them; and that in these two large adjacent islands, and at no great distance from the continent, there were only five species of quadrupeds, the largest of which exceeded not the size of a squirrel or a rabbit? Nothing can be a stronger proof of the empty and desert state of nature in these new lands. 'We found,' says Laet, 'in the island 'of St. Domingo but few species of quadrupeds, as the '*hutias*, which differs not much from our rabbit, but is 'only a little smaller, with short erect ears, and a tail 'like that of a mole; the *chemi*, which is nearly of the 'same form with the *hutias*, but somewhat larger; the '*molui*, which is smaller than the *hutias*; the *cori*, of 'equal size with the rabbit; its mouth resembles that 'of the mole; it has no tail, and its legs are short; some 'of them are black, but oftener a mixture of black and 'white; it is a domestic animal, and very tame; besides 'a small kind of *dogs*, which were absolutely mute; 'their number is now much diminished, because the 'European dogs have destroyed them.

'In the islands of St. Domingo, Cuba, and the An-'tilles,' says Acosta, 'there were hardly any of the ani-'mals belonging to the continent of America, and not 'one that resembled those of Europe.' All the sheep, 'goats, horses, oxen, and asses,' remarks Father du Tertre, 'in the Antilles, in Guadaloupe, and in all the 'French islands, have been brought there by the people 'of that nation; for none were carried there by the Spa-'niards, because the Antilles were then so thickly covered 'with wood that the cattle could find no herbage for 'their subsistence.' M. Fabry, who traversed during fifteen months the western territories of America beyond the Missisippi, assured me, that he often travelled three or four hundred leagues without seeing a single man. All our military gentlemen, who went from Quebec to the river Ohio, and from the Ohio to Louisiana, agree, that a person may frequently travel one or two hundred leagues in the depth of the forests and not meet with a single family of savages. All these testimonies show the desert and melancholy state of the New Continent, even where the temperature of the climate is most agreeable. But what is more directly to our present purpose, they destroy the

posterior evidence of our nomenclators, and describers of cabinets, who people the New World with the animals peculiar to the Old, and mark others as natives of particular countries where they never existed. For example, it is certain, that in St. Domingo, there were originally no quadrupeds larger than a rabbit; and though there had, they would have been devoured by the European dogs, which soon became as wild and ferocious as wolves: however, to the *marac* or *maracai* of Brasil, they have given the name of the tiger-cat of St. Domingo, though it is no where found but on the continent. They have made the scaly lizard, or long-tailed manis of Java, an American animal, called *tatoe* by the Brasilians, which is peculiar to the East Indies: they maintain, that the civet, which is a native of the southern parts of the Old Continent, is found also in New Spain, without considering that a creature so useful, which is reared in several parts of Africa, of the Levant, and the Indies, as a domestic animal, for the purposes of collecting the musk, an important article of commerce, would not have been neglected by the Spaniards, if the civets really existed in New Spain.

But our nomenclators have likewise denied to America some animals to which she has an original title. They have placed the opossum in the East Indies, and the sloth in Ceylon, though these animals belong solely to the New World, and are so remarkable, the one for a sac under its belly, in which it carries its young, the other for the extreme slowness of all its movements, that if they existed in the East Indies, travellers could never have passed them over in silence. Seba relies on the authority of Francis Valantine for the East Indian opossum. But this authority can have no weight; for Francis Valantine was so ignorant of the quadrupeds and fishes of Amboyna, and his descriptions are so bad, that Artedi declares no use can be made of his information.

We pretend not, however, to affirm absolutely, that none of the quadrupeds in the warm climates are common to both continents. Of this we can have no physical certainty, till the whole of them be accurately examined. But it is evident that none of the large, and very few of the small American animals, exist in the Old Continent. Besides, though there should be some exceptions, which I hardly imagine, they must be limited to a very small number of animals, and could have no influence on the general law which I mean to establish, and which seems to be the only rule for enabling us to acquire a proper knowledge of the animal kingdom. This law, which leads us to judge as much by the climate and dispositions of animals, as by their figure and structure, will seldom deceive, and will enable us to avoid or detect a multiplicity of errors. Suppose the question, for example, to be concerning an Arabian animal, as the hyæna, we may safely pronounce that it exists not in Lapland; but we will never maintain, with some naturalists, that the hyæna and glutton are the same animal, nor with Kolbe, that the cross-fox, which inhabits the most northern regions of the New Continent, is found at the Cape of Good Hope; and we will find, that this animal is not a fox, but a jackal: neither should the animal, called by the same author the *earth-hog*, which feeds upon ants, be confounded with the ant-eaters of America: this Cape animal is probably the manis or scaly lizard, which has no other resemblance to the ant-eater, than that of using the same food. In the same manner, if it had been considered, that the rein-deer is a northern animal, this name would have never been applied to an African antelope. The phoca, or seal, which frequents the seas of the north, ought not to be found at the Cape of Good Hope. The genet, which is a native of Spain, Asia Minor, &c. and peculiar to the Old Continent, is ranked by Klein under the name of *coati*, which is an American animal. The *ysquiepatl* of Mexico, an animal which exhales an offensive odour, and for that reason we shall rank it with the polecats, should never be considered as a small fox or badger. The *coati mondi* of America should not be confounded, as has been done by Aldrovandus, with the badger-hog, which is always mentioned as an European animal. But I mean not to exhibit all the errors of nomenclators. My aim is to prove, that their blunders would not have been so numerous, if they had attended to the difference of climates; if they had studied the histories of animals, and discovered, as I have done, that those of the southern parts of each Continent are never found in both; and lastly, if they had abstained from generic names, by which numbers of species, not only different, but very remote from each other, are blended together.

Thus the genuine object of a nomenclator is not to lengthen, but to contract his list, by making impartial inquiries and comparisons. No task can be easier than to peruse all the writers on animals, and to form a table of their names and phrases, which will always be longer in proportion as the labour bestowed in investigation is less: but nothing is more difficult than to examine and compare animals with that judgment and discernment, which are necessary to reduce this table to its just dimensions. I again repeat, that there are not in the whole habitable earth above two hundred species of quadrupeds, even including forty different species of monkeys. To each of these, therefore, we have only to allot a proper name; and a very indifferent memory is able to retain two hundred names. For what purpose, then, are quadrupeds arranged into classes, orders, and genera? Methodical distributions are only a kind of scaffolds invented to aid the memory in the recollection of plants, the number of which is so great, their distinctions so minute, and their species so liable to variation, that it is necessary to consider them in bundles or

genera, by putting together such as have the greatest similarity to each other. As in all works of genius, what is absolutely useless, is always ill-imagined, and often becomes hurtful, instead of giving names to two hundred quadrupeds, we have dictionaries loaded with such a variety of terms and phrases, that it would require more labour to explain, than was spent in composing them. Why employ a phraseological jargon, when we can speak plain language, by pronouncing simple names? Why change all the acceptation of terms, under the pretext of making classes and genera? When a genus is composed of a dozen of animals, under the name, for example, of the *rabbit*, why is not the rabbit itself to be found there, but must be sought for under the genus of *hare?* Is it not absurd, and even ridiculous, to fabricate classes, where genera the most remote are assembled together; for example, to unite in the first, *man* and the *bat;* in the second, the *elephant* and *scaly lizard;* in the third, the *lion* and the *ferret;* in the fourth, the *hog* and the *mole;* in the fifth, the *rhinoceros* and the *rat?* &c. Such heterogeneous and ill-conceived ideas cannot be supported. The works, accordingly, which contain fancies so crude, have been successively destroyed by their own authors. One edition contradicts another, and the whole receives no applause but from tyros and children, who are uniformly the dupes of mystery, to whom the fopperies of method appear to be scientific, and, in fine, who respect their master in proportion to the talent he possesses of representing the clearest and most perspicuous objects under the most abstruse and dark points of view.

But I have dwelt, perhaps, too long on criticisms of this kind, especially as they are not my principal object. I have said enough to guard the reader against errors both of a general and particular kind, which are no where so numerous as in the works of nomenclators; because, being solicitous to comprehend every thing within the limits of their systems, they are obliged to associate all that they are ignorant of with the little that they know.

From what has been advanced, the following general conclusions may be drawn: that man is the only animated being on whom Nature has bestowed sufficient strength, genius, and ductility, to enable him to subsist and to multiply in every climate of the earth. No other animal, it is evident, has obtained this great privilege; for instead of multiplying every where, most of them are limited to certain climates, and even to particular countries. Man is totally a production of heaven: but the animals, in many respects, are creatures of the earth only. Those of one Continent are not found in another; or if there are a few exceptions, the animals are so changed and contracted, that they are hardly to be recognised. Is any farther argument necessary to convince us, that the model of their form is not unalterable; that their nature, less fixed than that of man, may be varied, and even absolutely changed in a succession of ages; that for the same reason, the least perfect, the least active, and the worst defended, as well as the most delicate and heavy species, have already, or will soon disappear; for their very existence depends on the form which man gives or allows to the surface of the earth?

The prodigious *mammoth*, whose enormous bones I have often viewed with astonishment, and which were at least six times larger than those of the largest elephant, has now no existence; yet the remains of him have been found in many places remote from each other, as in Ireland, Siberia, Louisiana, &c. This species was unquestionably the largest and strongest of all quadrupeds; and since it has disappeared, how many smaller, weaker, and less remarkable species must likewise have perished, without leaving any evidence of their past existence? How many others have undergone such changes, either from degeneration or improvement, occasioned by the great vicissitudes of the earth and waters, the neglect or cultivation of Nature, the continued influence of favourable or hostile climates, that they are now no longer the same creatures? Yet the quadrupeds, next to man, are beings whose nature and form are the most permanent. Birds and fishes are subject to greater variations: the insect tribes are liable to still greater vicissitudes: and if we descend to vegetables, which ought not to be excluded from animated Nature, our wonder will be excited by the quickness and facility with which they assume new forms.

Hence it is not impossible, that without inverting the order of Nature, all the animals of the New World were originally the same with those of the Old, from whom they derived their existence; but that being afterwards separated by immense seas, or impassable lands, they would in the progress of time suffer all the effects of a climate that had become new to them, and must have had its qualities changed by the very causes which produced the separation, and consequently degenerate, &c. But these circumstances should not prevent them from being now regarded as different species of animals. From whatever cause these changes produced by the operation of time and the influence of climate have originated, and though we should date them from the creation itself, they are not the less real. Nature, I allow, is in a perpetual state of fluctuation: but it is enough for man to seize her in his own age, and to look backward and forward, in order to discover her former condition, and what future appearances she may probably assume.

With regard to the utility of this mode of comparing animals, it is evident, that independent of ascertaining names, of which some examples have been given, it extends our knowledge of the animal creation, and renders it more certain and perfect; that it prevents us from

ascribing to American animals, properties which are peculiar to those of the East Indies, only because they have the same name; that in examining the notices of foreign animals communicated by travellers, it will enable us to distinguish names and facts, and to refer each to its proper species; and lastly, that it will render the history which I am now composing less defective, and perhaps more conspicuous and complete.

THE TIGER.

THE tiger has six cutting and two canine teeth in each jaw; five toes before, and four behind. The claws are sharp, hooked, lodged in a sheath, and may be exerted or drawn in at pleasure. The head is round, the visage short, and the tongue rough. Both the head and body of the tiger are smooth. He has vast strength in his limbs. His colour is a pale yellow, beautifully marked with long stripes of black, pointing from the back to the belly, and others across the thighs. The tail is about one third shorter than the body, and annulated with black. His size is often superior to that of the lion. The royal tiger is of a tremendous bulk. M. de Buffon mentions one that, tail included, was fifteen feet long. Du Halde says, that the Chinese tigers vary in colour, some being white, striped with black and gray.

In the class of carnivorous animals, the lion holds the first rank, and the tiger the second. As the first of a bad genus is always the largest, and has often the best dispositions, the second is generally the most rapacious and destructive. To pride, courage, and strength, the lion adds dignity, clemency, and magnanimity. But the tiger is grossly ferocious, and cruel, without necessity. The same thing takes place in all nature, where rank is the offspring of strength. The first, in which all power resides, is less tyrannical than his immediate inferior, who, unable to obtain unlimited power, avenges himself, by abusing that portion of it which he enjoys. Thus the tiger is more to be dreaded than the lion. The latter often forgets that he is the sovereign, or the strongest of all animals. He moves forward with tranquillity and steadiness, and never attacks man, unless when provoked. He never runs with precipitation, nor gives chase, but when pressed with hunger. The tiger, on the contrary, though satiated with carnage, seems to be perpetually thirsting for blood. His fury has no intervals, but during the time he is obliged to lie in ambush for prey at the sides of rivers. He seizes and tears to pieces a fresh animal with the same rage that he exerted in devouring the first. He desolates the country which he inhabits, and fears neither the aspect nor the arms of man. He puts to death whole flocks of domestic animals, and all the wild beasts which come in his way: he attacks the young elephant and rhinoceros, and sometimes even ventures to brave the lion.

The form of the body generally accords with the natural disposition. The air of the lion is noble; the height of his limbs is proportioned to the length of his body. His large thick mane, which covers his shoulders, and forms a shade to his face, his determined aspect, his grave demeanour, all concur in announcing his proud and majestic intrepidity. The too great length of the body of the tiger, and his disproportionately short limbs, his naked head, his haggard eyes, and his blood coloured tongue, which always lolls out of his mouth, are marks of ignoble malice and insatiable cruelty. He has no instinct but perpetual rage, a blind and undistinguishing ferocity, which often impels him to devour his own young, and to tear in pieces their mother, when she attempts to defend them. May this excessive thirst for blood never be allayed, till he has destroyed the whole race of monsters which he produces!

It is a fortunate circumstance for the other animals, that the species of the tiger is not numerous, and appears to be confined to the warmest regions of the East Indies. Tigers are found in Malabar, in Siam, in Bengal, the same countries which are inhabited by the elephant and rhinoceros. They are even said to follow the rhinoceros for the purpose of eating his dung, which both refreshes and purges them. Like him, they frequent the borders of rivers and lakes; for as blood only augments their thirst, they have often occasion for water, to cool the fervour which consumes them. Besides, they watch near the waters, the approach of animals, which the heat of the climate obliges to resort thither several times every day. Here they procure their prey, or rather multiply their massacres; for they often leave the creatures they have recently killed, to devour others. They delight in blood, and glut themselves with it till they are intoxicated. They tear the body for no other purpose than to plunge their head into it, and to drink large draughts of blood, the sources of which are generally exhausted before their thirst is appeased.

When, however, the tiger kills large animals, as a horse or a buffalo, he does not tear out their bowels on

the spot; but to prevent interruption, and that he may devour them at leisure, he drags them off to the wood with such incredible swiftness, that his course seems to be hardly retarded by their enormous weight. This circumstance is sufficient to give an idea of his strength; but it will be rendered still clearer by attending to the dimensions of his body. Some travellers have compared him to the horse, others to the buffalo, and others have only said that he is much larger than the lion. [The tigers of India, says Boullaye-le-Gouz, are of a prodigious size. I have seen skins of them longer and wider than that of a buffalo. They are sometimes addicted to eat men; and in many parts of India, no man travels without being well armed, because the tiger, whose figure resembles that of a cat, raises himself on his hind legs, and leaps upon the person he attacks.] But we have authorities more recent, and above all suspicion. We are assured by M. de la Lande-Magon, that he has seen, in the East Indies, a tiger of fifteen feet in length, including the tail, which, supposing it to be four or five feet, the length of the body was at least ten. The skin preserved in the royal cabinet, it is true, exceeds not seven feet from the extremity of the muzzle to the origin of the tail. But the tiger to which it belonged was taken when very young, and was ever afterwards confined in a narrow apartment, where the want of exercise and room, the languor and restraint of confinement, and unnatural food, shortened his life, and prevented the proper extension of his body. In the history of the stag, it was remarked that these animals when taken young, and shut up in parks too small, not only never acquired their natural size, but became deformed and ricketty. We likewise learn, from the dissections of every species of animals brought up in houses or court yards, that their bodies and members, for want of exercise, never acquire their natural dimensions; that such organs as cannot be used, as those of generation, are so minute, in all captive and solitary animals, that it is difficult to discover them. The difference of climate alone may produce the same effects as confinement and want of exercise. Animals peculiar to warm climates, though left at liberty, and well fed, are incapable of multiplying in cold countries: and reproduction being the natural effect of copious nutrition, it is evident, that as the former faculty is destroyed, the latter must also be incomplete; and that in these animals, cold alone is sufficient to restrain the action of the internal mould, and to diminish growth, since it is capable of obliterating the power of reproduction.

It is not therefore surprising, that this tiger, whose skin and skeleton is preserved in the royal cabinet, should not have acquired its natural size. The bare inspection, however, of this stuffed skin, and of the skeleton, conveys an idea of a most formidable animal. Upon the bones of the leg, there are rugosities, or impressions, which indicate the attachment of muscles still stronger than those of the lion. These bones are also equally strong, though shorter; and as formerly remarked, the height of the tiger's legs is not proportioned to the great length of his body. Hence the incredible swiftness ascribed to him by Pliny, and which is implied in the name of the animal, cannot be attributed to his ordinary movements, nor even to the quickness of a continued course; for it is apparent from the shortness of his legs, that he can neither walk nor run with such celerity as those animals whose legs are proportionally longer. But this prodigious swiftness may, with propriety, be applied to the terrible bounds which he makes without any extraordinary effort; for if we suppose his strength and suppleness to be proportioned to those of the cat, which he greatly resembles in structure, and which leaps in an instant to the distance of many feet, the tiger, whose body is ten times longer, may nearly in the same instant leap many fathoms. Hence it is not the celerity of his course, but the quickness of his leap, which Pliny meant to describe, and which renders this animal tremendous, because it is impossible to avoid him after he makes his spring. [The terrible swiftness, says Bontius, ascribed by Pliny to this animal, is an error. On the contrary, he runs slowly; and this is the reason why he more willingly attacks men than swift animals, as the stag, the wild boar, the buffalo, or the wild ox, and why he attacks all animals by ambuscade. He darts with impetuosity upon their heads, and beats the strongest animals to the ground with a single stroke of his paw.] It is easy to reconcile these facts with the expressions of Pliny.

The tiger is perhaps the only animal whose ferocity cannot be subdued. Neither violence nor restraint have any effect in softening his temper. He is equally irritated with gentle or rough treatment. The mild influence of society makes no impression on the obduracy of his nature. Time, instead of mollifying the ferociousness of his humour, only exasperates his rage. With equal wrath he tears the hand which feeds him, as that which is lifted up to strike him. He roars at the sight of every thing that lives. Every object appears to him as a fresh prey, which he devours beforehand with the avidity of his eyes, menaces with frightful groans, and the grinding of his teeth, and often darts upon it, without regarding his chains, which only restrain, but cannot calm his fury.

To complete the idea of the strength of this animal, we shall give Father Tachard's relation of a combat between a tiger and two elephants. 'A palisade,' says this 'author, of about a hundred paces square, was erected. 'Into this inclosure two elephants were introduced, for the 'purpose of fighting a tiger. They were defended by a 'kind of plastron, in the form of a mask, which covered 'the head and a part of the trunk. As soon as we

'arrived, a large tiger was brought out of his lodge. His 'colour and figure were new to the Frenchmen who 'were present at this combat; for he was not only 'much longer and thicker than those we have seen in 'France, but his skin was differently spotted. Instead 'of spots scattered without order, he had long, broad, 'circular bands, which, arising from the back, joined 'below the belly, and were continued along the tail, in 'the form of alternate white and black rings. There 'was nothing peculiar in his head or limbs except that 'they were larger than those of common tigers, though 'the animal had not yet acquired his full growth; for 'M. Constance informed us, that there were tigers in 'that kingdom three times larger; and that when hunt-'ing along with the king he had once seen a tiger nearly 'as large as the biggest mule. They have also a smaller 'kind, like that brought from Africa to Europe, one of 'which I was shown the same day at Luovo.

'The tiger destined for the combat was not let loose, 'but was so fixed by two cords, that having no liberty 'to spring, the first elephant which approached him gave 'him two or three blows on the back with his trunk. 'these strokes were so heavy that they beat the tiger to 'the ground, where he lay for some time as if he had 'been dead. But though this first attack had abated his 'fury, he was no sooner untied than he gave a horrible 'roar, and made a spring at the elephant's trunk, which 'was stretched out to strike him. The elephant how-'ever dexterously drew up his trunk, protected it with 'his tusks, which he presented at the same time, and 'with them he threw the tiger to a great height in the 'air. The tiger was so stunned that he made no farther 'advances, but took several turns round the palisade, 'and sometimes sprung towards the people in the gal-'leries. Three elephants were then set upon him, each 'of whom in their turn gave him such blows, that he 'again seemed to be dead, and afterwards endeavoured 'only to avoid his enemies, who would unquestionably 'have killed him if an end had not been put to the 'combat.' Even from Father Tachard's description it is plain that the tiger he saw fight with the elephants was the true tiger; that he appeared to be a new animal to the Frenchmen, because they had probably seen in France only African panthers or leopards, or rather the American jaguars; and that the small tiger he saw at Luovo was nothing but a panther. We may likewise conceive from this simple narrative the amazing strength and ferocity of the tiger. Though young and not arrived at his full growth, though a captive and bound with ropes, though single against three, yet this tiger was so formidable to these enormous animals, that all the parts of their bodies which nature had not defended with an impenetrable skin were obliged to be covered with plas-trons or cushions.

The tiger, of which an anatomical description was made by the Jesuits at China, and communicated to the Academy of Sciences by Father Gouie, seemed to be the genuine tiger, as well as that called the *royal tiger*, mentioned by Perrault, in his memoirs concerning animals, and of which he says the description was made in Siam. Dellon, in his voyages, mentions expressly, that tigers are more frequent in Malabar than in any other part of the East Indies; that there are several species of them; but that the largest, which is as big as a horse, and called the royal tiger by the Portuguese, is extremely rare.

[The spotted tiger is the only one known in Europe. But in Tartary and China there are tigers with black bands or belts; and even in these countries two species are mentioned, though no other differences appear to exist. The tiger dissected by the Jesuits of China, which had been killed in the chase by the emperor, along with the other four, weighed only 265 pounds, and consequently was none of the largest; another of them weighed 400 pounds. The one that was dissected had a third part of his stomach filled with worms, though it is not said he was in a putrid state. Some of the people who were present remarked, that they had ob-served the same appearance in a tiger that was dissected at Macao.]

The royal tiger therefore appears not to be a different species. He is found in the East Indies only, and not in Brasil, as has been alledged by some of our natu-ralists. I am even inclined to believe that the true tiger is peculiar to Asia, and the interior parts of the south of Africa; for though most travellers who have visited the coasts of Africa mention tigers, yet it is easy to per-ceive, from their descriptions, that they are not genuine tigers, but leopards, panthers, ounces, &c. Doctor Shaw remarks, that in the kingdoms of Tunis and Algiers the lion and panther hold the first rank among the rapacious animals; but that the tiger is not found in this part of Barbary. Doctor Shaw's observation seems to be just; for they were Indian not African ambassadors who pre-sented to Augustus, when at Samos, the first tiger that was ever seen by the Romans. It was also from India that Heliogabalus procured those tigers with which he wished to have his chariot drawn, when he wanted to personate the god Bacchus.

Thus the species of the tiger has always been more rare and less diffused than that of the lion. The female however, like the lioness, produces four or five cubs at a litter. She is furious at all times; but her rage rises to the utmost extremity when robbed of her young. She then braves every danger; she pursues the plunderers, who are often obliged to release one in order to retard her motion. She stops, takes it up, and carries it off to the nearest cover; but she instantly returns, and continues the pursuit after the spoilers to the very gates of their villages or to their boats. When all hope

of recovering them is lost, she expresses the exquisiteness of her sorrow by dismal and hideous howlings, which excite terror wherever they reach.

The tiger, like the lion, moves the skin of his face, grinds his teeth, and roars; but the sound of his voice, which has by some travellers been compared to that of certain large birds, is different. It is expressive of a hoarse and frightful cry.

The skin of these animals is much esteemed, especially in China. The military mandarines, in their public marches, cover their sedans, and likewise their pillows during the winter, with tigers skins. In Europe these skins, though rare, are not much valued. Those of the leopard of Guinea and Senegal, called tigers skins by our furriers, are preferred. Besides, the skin is the only use that can be derived from this most noxious of all quadrupeds. His sweat and the hair of his whiskers are alledged to be certain poisons to man and other animals. But he does so much real mischief when alive, that it is needless to ascribe imaginary evils to his remains; for the Indians eat his flesh, and find it neither unwholesome nor disagreeable; and if a pill composed of his whiskers is mortal, this effect is produced by the sharpness and roughness of the hair, which acts on the stomach in the same manner as small needles.

THE PANTHER, OUNCE, AND LEOPARD.

To remove all ambiguities, arising from the use of improper names, or other causes, let it be remarked, that beside the tigers whose history and description I have already given, Asia and Africa afford other three species of this genus, all different from the tiger and from each other. These three species are the panther, the ounce, and the leopard, which naturalists have not only confounded with one another, but with species of the same genus peculiar to America. Of the latter I shall here take no notice, but confine myself solely to those of the Old Continent.

The generic characters of the panther are the same with those of all the cat kind. The panther has smooth short hair of a bright tawny colour. The back, sides, and flanks are elegantly marked with black spots, disposed in circles from four to five in each, with a single black spot in the centre. In the face and legs there are single spots only. On the top of the back there is a row of oblong spots, the largest nearest the tail. The chest and belly are white, the first being marked with transverse dusky stripes. On the tail and belly the black spots are irregular. The ears are short and pointed; the end of the nose is brown; and the limbs are very strong. The skin of one I measured was, from the extremity of the nose to the origin of the tail, six feet ten inches long, and the tail near three.

The first species is the panther, which was known to the Greeks by the name *pardalis*, to the ancient Latins by that of *panthera* and *pardus*, and to the more modern Latins by that of *leopardus*. The body of this animal, when arrived at full growth, is five or six feet long, measuring from tne extremity of the muzzle to the origin of the tail, which is more than two feet. The basis of the colour upon the back and sides is of a more or less deep yellow, and that of the belly is whitish. He is marked with black spots which are circular, or in the form of a rose, detached from each other upon the sides, hollow in the middle, and most of them have several lesser spots in their center of the same colour. These spots, of which some are oblong, and others circular, are frequently three inches in diameter. The spots on the head, breast, belly, and legs, are entire.

The second species is the little panther of Oppian, to which the ancients have assigned no particular name; but modern travellers have called it *ounce*, from the corrupted term *lynx* or *lunx*. We shall adopt the name *ounce*, because the animal has some affinity to the lynx. The ounce is much smaller than the panther, being only about three feet and a half long, which is nearly the size of the lynx. The length of the hair exceeds that of the panther, as well as that of the tail, which is sometimes more than three feet in length, though the body of the ounce is upon the whole one third less than that of the panther, whose tail is only about two feet and a half. The ground colour of the ounce is a whitish gray upon the back and sides, and the gray is still whiter on the belly. But the back and sides of the panther are always of a more or less deep yellow colour. The spots are nearly of the same figure and size in the one as in the other.

[The ounce has a large head, short ears, and long hair on the whole body, of a whitish ash-colour, tinged with yellow, which is fainter in the breast and belly. It is marked with small round spots. There is a large black spot behind each ear. The upper part of the neck is varied with large single spots; the sides of the back with longitudinal marks, consisting of several spots almost touching each other, leaving the ground colour of the body in the middle. The spots beneath these are irregular, large, and full. Those on the legs are small and

thinly dispersed. The tail is full of hair, and irregularly marked with large black spots. This species is of a strong make, being long backed and short legged. The length from the nose to the tail is about three feet and a half, and that of the tail is upwards of three feet.]

The third species is peculiar to Senegal, Guinea, and other southern regions, which had not been discovered by the ancients; and of course they had no knowledge of this animal, which we shall call the *Leopard*, a name that has been improperly applied to the great panther. The leopard is larger than the ounce, but much less than the panther, seldom exceeding four feet in length. The tail is two or two and a half feet long. The ground colour of the hair, upon the back and sides, is yellow; that of the belly is whitish. The spots are annular, or like roses, but much smaller than those of the panther and ounce, and most of them are composed of four or five small spots: some of the latter are irregularly disposed.

These three species, as we have seen, are perfectly distinct. The merchants call the skins of the first species, *panther skins*, those of the second, which we have denominated the *ounce*, *African tigers' skins*, and those of the third, or leopard, though very improperly, *tigers' skins*.

Oppian was acquainted with the panther and ounce; of the former he remarks, that there were two kinds, the one large and the other small, though the form of their bodies, and the disposition of the spots, were similar; but that they differed in the length of their tail, which was longer in the small than in the large species. The Arabs call the great panther *Nemer*, and the smaller kind *Phet* or *Phed*, which last, though a little corrupted, is the same with *Faadh*, and is the real Barbary name of this animal. 'The Faadh,' says Dr. Shaw, 'resembles 'the leopard, (he means the panther), by having the 'same spots; but they differ in other respects; for the 'skin of the former is darker and coarser, and he is not 'so ferocious as the latter.' Besides, we learn from a passage of Albert, commented upon by Gesner, that the *Phet* or *Phed* of the Arabs, is denoted in Italian, and some other European languages, by the word *Leunza* or *Lonza*. Hence it is evident, that the small panther of Oppian, and the Arabian *Phet* or *Phed*, the Barbary *Faadh*, and the European *Onze* or *Ounce*, are the same animal, which is also probably the *Pard* or *Pardus* of the ancients, and the *Panthera* of Pliny; for he says, that the ground colour of the panther was white, but that of the great panther, as formerly observed, is yellow. It is besides, probable, that the small panther was called simply *Pard* or *Pardus*, and that they afterwards named the large panther *Leopard* or *Leopardus*; because they imagined it was a mongrel species, increased in size by mixing with that of the lion. But as there is no foundation for this fancy, we have preferred the simple and primitive name *panther*, to the modern compound one, *Leopard*, which last we have applied to a new animal, that has hitherto been mentioned under equivocal appellations only.

Thus the ounce differs from the panther by being smaller, having a longer tail, and also longer hair, of a whitish gray colour; and the leopard differs from both the panther and ounce, by his brilliant yellow robe, though more or less deep; by the smallness of his spots; and by their being disposed in groups, as if each of them were formed by the union of four or five.

Pliny, and several posterior authors, say, that the robe of the female panther was whiter than that of the male. This may be true of the ounce: but we have observed no such distinction in the panthers kept at Versailles, which were drawn from the life. Hence, if there is any difference between the male and female, it can neither be constant nor sensible. We have indeed perceived shades more or less strong, in some skins of these animals; but it is probable that this difference depends more on the difference of age or of climate than upon that of sex.

The animals described and dissected by the gentlemen of the Academy of Sciences, under the name of *tigers*, and that described by Caius, in Gesner, under the name of *Uncia*, are of the same species with our leopard. Of this not a doubt can reman, after comparing the figure and description with those of Caius and M. Perrault. The latter indeed says, that the animals described and dissected by the gentlemen of the Academy under the appellation of *tigers*, were not the ounce of Caius. But the only reasons he assigns are, that the ounce is smaller, and is not white under the belly. However, if M. Perrault had compared the description of Caius with the subjects he examined, I am persuaded that he would have perceived no difference between them and the ounce of Caius. It may be remarked, that Caius without giving the precise dimensions of the animal's body, says, that it is larger than the shepherd's dog, and as thick, though it be shorter, as the bull-dog: I cannot conceive therefore how M. Perrault should have said, that the ounce of Caius was much smaller than the tigers dissected by the gentlemen of the Academy. These animals, from the extremity of the muzzle to the origin of the tail, measured only four feet in length. The leopard which we have described, and which is unquestionably the same animal with the tigers of M. Perrault, was likewise about four feet long; and if we measure a bull-dog, and particularly a mastiff, we will find that he often exceeds these dimensions. Thus the tigers described by the gentlemen of the Academy differ not so much in size from the ounce of Caius, as to justify M. Perrault's conclusion, that they were not the same animal. The

second difference is that of the colour of the hair on the belly, which M. Perrault says is white, and Caius ash-coloured, that is, whitish. Hence these two characters, which induced M. Perrault to think that the tigers dissected by the gentlemen of the Academy were not the ounce of Caius, should have led him to the opposite conclusion, especially if he had attended to the rest of the description, which perfectly agrees. We must, therefore, regard the tigers of the gentlemen of the Academy, the ounce of Caius, and our leopard, as the same animal; and I cannot conceive how some naturalists should have mistaken M. Perrault's tigers for American animals, and confounded them with the jaguar.

I consider it therefore as certain, that the tigers of Perrault, the uncia of Caius, and our leopard, are the same animal, and that our panther is the same with the panther of the ancients; for except in the size, our panther agrees with the ancient in every other character; and this inconsiderable difference may be safely ascribed to confinement and want of exercise. This difference of dimensions at first perplexed me. But after a minute comparison of the large skins sold by the furriers with that of our panther, there could be no longer any doubt that they were the very same creatures. The panther we have described, as well as other two of the same species, kept at Versailles, came from Barbary: the two first were presented to his Majesty by the regency of Algiers, about twelve years ago; and the third was purchased by the King from an Algerine Jew.

Another remark must be made. Of the three animals above described under the appellations of the *panther*, the *ounce*, and the *leopard*, not a single one can be referred to the animal which naturalists have indicated by the name of *pardus* or *leopardus*. The *pardus* of Linnæus, and the *leopard* of Brisson, which appear to be the same animal; in a word, the panther found in Africa and the East Indies, which these authors mean to point out by the above definitions. From the accurate researches I have made, I am perfectly satisfied that these three animals, and perhaps a fourth, to be afterwards mentioned, which likewise has not this character of long spots on the belly, are the only species of this genus to be found in Asia or Africa. We must therefore hold this character of our nomenclators to be fictitious; for in all the animals of this kind, both in the Old and New Continent, when they have long spots, these spots are uniformly situated on the superior parts of the body, as the neck and back, and never on the inferior parts.

In fine, when perusing the writings of the ancients, the *panther* should not be confounded with the *panthera*. The *panthera* is the animal we have described; but the *panther* of Homer and other authors, is a kind of timid wolf, perhaps the jackal, as shall be explained in the history of that animal. Besides, the word *pardalis* is the ancient Greek name of the true panther, and is applied indiscriminately to both male and female. The word *pardus* is more modern, being first used by Lucan and Pliny. *Leopardus* is still less ancient; for it appears to have been first employed by Julius Capitolinus: and *panthera* was derived from the Greek by the ancient Latins, but never used by the Greeks themselves.

After dispelling the darkness with which nomenclators perpetually obscure Nature, after removing every source of ambiguity, we shall now proceed to remark what is peculiar to each of them.

The panther, which we have examined alive, has a ferocious air, a restless eye, a cruel aspect, brisk movements, and a cry similar to that of an enraged dog, but stronger and more hoarse. He has a rough and very red tongue, strong and pointed teeth, hard sharp claws, a beautiful skin, of a more or less deep yellow colour, variegated with black circular spots, or united in the form of roses, and short hair. The upper part of the tail is marked with large black spots, and with rings of black and white toward the extremity. He is of the size and make of a mastiff dog, but his legs are not so long.

The relations of travellers agree with the testimonies of the ancients, as to the large and small panther, that is, our panther and ounce. It appears, that there now exist, as in the days of Oppian, in that part of Africa which extends along the Mediterranean, and in those parts of Asia that were known to the ancients, two species of panthers, and most travellers have called the larger the *panther* or *leopard*, and the smaller the *ounce*. They all agree that the ounce is easily tamed, that he is trained to hunting, and employed for this purpose in Persia, and several other provinces of Asia; that some ounces are so small, that a horseman carries them on the crupper behind him; and that they are so gentle as to admit of being handled and caressed.

[The Persians have a quadruped called the *ounce*, whose skin is spotted like that of a tiger; but he is very tame and gentle. A horseman carries it on a truss behind him; and when he perceives an antelope he makes the ounce descend, which is so nimble that in three bounds it leaps on the neck of the antelope, though the latter runs with incredible swiftness. The antelope is a small species of roe-deer, which are very numerous in this country. The ounce soon kills the antelope with his sharp teeth. But if he misses his blow, and the antelope escapes, he remains fixed on the spot in a confused and mortified condition. In these moments of distress and disappointment an infant may apprehend him without the least resistance.—*Voyage de Tavernier.*

In great hunting matches the Persians train ferocious animals to the chase, as lions, tigers, leopards, panthers, and ounces; the latter of which are called *youzze*. They do no injury to man. A horseman carries one behind him, with its eyes covered by a cloth, and it is fixed by

a chain. When the hunter perceives any game he uncovers the animal's eyes, and turns its head to the prey. If he spies it he darts upon it with great bounds, throws himself upon it, and brings it to the ground. If after making a few leaps he misses his object, he is discouraged, and commonly stops. The hunter takes him up, and consoles him with caresses. Some of these trained animals hunt with great dexterity, creeping on their bellies through hedges and brushwood till they are near their prey, and then darting upon them. *Voy. de Chardin.*]

The panther seems to be of a more fierce and untractable nature than the ounce. Man may be said rather to subdue than to tame him. He never loses entirely his ferocious disposition; and when destined for the chase great attention is necessary in training him, and still greater caution is requisite in conducting and exercising him. He is led in a cart, shut up in a cage, the door of which is opened when game appears. He springs towards the animal, and generally at three or four bounds seizes and strangles it; but if he misses his blow, he becomes furious, and sometimes attacks his master, who commonly prevents this hazard by carrying along with him pieces of flesh, or live animals, as lambs or kids, one of which he throws to him to appease his rage.

[When the hunter discovers the antelopes, he endeavours to show them to the leopard, which is chained upon a small cart. This cunning animal does not instantly run at them, as might be imagined, but winds about, creeping and concealing himself, in order to approach and surprise them; and as he is capable of making five or six springs with incredible rapidity, when he has advanced near enough, he darts upon them, strangles them in an instant, and gluts himself with their blood, their heart, and their liver. But if he misses his aim, which sometimes happens, he stands still, and never attempts to pursue them, which would be in vain; for they run much swifter and longer than he is able. His master then approaches him gently, flattering and amusing him with pieces of flesh, till he throws a cover over his eyes, puts on his chains, and leads him back to the cart. *Voy. de Bernier.*]

This description can only apply to the large panther; because no such precautions are necessary with the ounce.

The species of the ounce seem to be more numerous and more diffused than that of the panther. Ounces are very common in Barbary, Arabia, and all the southern parts of Asia, Egypt perhaps excepted. They even extend as far as China, where they are called *hinen-pao.*

The ounce is used for hunting in the warm climates of Asia; because dogs are very scarce in these countries, having hardly any but what are transported thither, and even these lose in a short time their voice and their instinct.

[As the Moors at Surat and on the Malabar coasts have no dogs to hunt the antelopes and fallow-deer, they endeavour to supply this defect by taming and training leopards. These animals attack their prey with great address, and after seizing it, they never quit, but remain firmly fixed upon it.]

Besides the panther, the ounce, and the leopard, have such an antipathy to dogs, that they attack them preferably to all other animals. In Europe our hunting dogs have no enemy but the wolf. But in countries filled with tigers, lions, panthers, leopards, and ounces, which are all stronger and more cruel than the wolf, it it impossible to preserve dogs. The scent of the ounce is not near so fine as that of the dog. He neither follows animals by their foot, nor is he able to overtake them in a continued chase. He hunts solely by the eye, and makes only a few springs at his prey. He is so nimble that he easily clears a ditch or a wall of many feet. He often climbs trees to watch passing animals, and suddenly darts down upon them. This mode of seizing prey is common to the panther, the leopard, and the ounce.

The manners and dispositions of the leopard are the same with those of the panther. But I learn not that he has ever been tamed like the ounce, or that the negroes of Senegal or Guinea, where he is very common, ever use him for hunting. He is generally larger than the ounce, and smaller than the panther. His tail, though two or two and a half feet long, is shorter than that of the ounce.

[The Guinea leopard is generally of the size and stature of a large bull-dog. He is very ferocious, and incapable of being tamed. He attacks with fury every kind of animal, man not excepted. Neither the tigers nor lions of the Guinea coast do any injury to man, unless they are extremely pressed with hunger. The leopard partakes something of the lion, and something of the large wild cat. His skin is all marked with round spots of different shades of blackness upon a grayish ground. His head is of a middle size, his mouth is large and well armed with teeth, of which the women of that country make necklaces. His tongue is equally rough as that of the lion. His eyes are fiery, and continually in motion. His aspect is cruel, and indicates a perpetual thirst for blood. His ears are round, short, and always erect. He has a thick short neck, strong thighs, large feet, five toes on the fore and four on the hind feet, both armed with strong sharp claws, which he shuts like the fingers of a hand, and never looses them from his prey till he has torn it in pieces both with his claws and teeth. Though very rapacious and gluttonous he is always meagre. The leopards multiply very fast; but the tiger, who is stronger and more alert, is their deadly foe, and destroys great numbers of them. The negroes take the tiger, the leopard, and the lion, by means of deep pits covered with reeds and a little

earth, upon which they place some dead animal as a bait.

The tiger of Senegal is more furious than the lion. He is nearly about the length and height of a greyhound. He attacks indiscriminately man and all other animals. The negroes kill him with their darts and arrows, in order to procure his skin. Though their bodies be pierced in many places they defend themselves to the last drop of their blood, and often destroy some of the assailants.]

The leopard of Senegal and Guinea, to which we have particularly applied the name of *leopard* is probably the animal called *engoi* at Congou, and perhaps also the *antamba* of Madagascar. We mention these names, because it would increase our knowledge of animals, if we had lists of the names given them in the language of the countries they inhabit.

The species of the leopard appears to be subject to greater varieties than that of the panther or ounce. We have examined a greater number of leopard skins which differed from each other, either in the shades of the ground-colour, or in those of the annular spots, some of which were more distinctly defined than others. But these rings are always smaller than those of the panther or ounce. In all leopards skins the spots are nearly of the same size and figure; and their chief difference consists in the deepness or lightness of their colours. The ground-colour of the skin differs only by being of a more or less deep yellow. But as all these skins are nearly of the same size, both in the body and tail, it is probable that they belong to the same species of animal.

The panther, the ounce, and the leopard, inhabit Africa, and the warmest climates of Asia only. They have never spread over the northern or even the temperate regions. Aristotle mentions the panther as an African and Asiatic animal, and says expressly, that it existed not in Europe. Hence these animals, which seem to be confined to the Torrid Zone of the Old Continent, could never pass over to the New by the northern lands; and we shall find, by the descriptions we are to give of the American animals of this genus, that they are different species, and ought not to be confounded, as most of our nomenclators have done, with those of Asia or Africa.

These animals in general delight in the thickest forests, and often frequent the banks of rivers, and the environs of sequestrated habitations, where they endeavour to surprise domestic animals, and the wild beasts which come to the rivers in quest of water. They seldom attack men, even when provoked. They climb trees with great ease, where they pursue cats and other animals, which seldom escape them. Though they live solely on prey, and are commonly meagre, travellers pretend that their flesh is not bad. It is indeed eaten by the Indians and negroes; but they prefer the flesh of the dog, which they consider as the most delicious food. With regard to their skins they are all valuable, and make excellent furs. The most beautiful and dearest is that of the leopard, one of which, when the yellow is bright, and the spots very black and well defined, costs eight or ten louis-d'ors

THE JAGUAR.

THE hair of the jaguar, or Brasilian cat, is of a bright tawny colour. The top of the back is marked with long stripes of black, and the sides with irregular oblong spots, open in the middle, which is the ground colour of the hair. The thighs and legs are marked with full black spots. The breast and belly are whitish, and the tail not so long as the body: the upper part is a deep tawny, marked irregularly with large black spots, the lower part with smaller spots. It grows to the size of a wolf, and even larger.

The *jaguar* or *jaguara* is the Brasilian name of this animal, which we have adopted to distinguish it from the tiger, the panther, the ounce, and the leopard, with which it has often been confounded.

The jaguar resembles the ounce in size of body, in the figure of most of the spots, and even in dispositions. He is not so bold as the leopard or panther. Like the leopard, the ground colour of his hair is a beautiful yellow, and not gray like the ounce. His tail is shorter than that of either of these animals: his hair is longer than that of the panther, and shorter than that of the ounce: it is crisped when young, and smooth when he arrives at full growth. We have never seen this animal alive; but had one sent us well preserved in spirits. It had been taken young, and brought up in the house till it was two years old, when it was killed in order to be transmitted to us. It had not therefore acquired its natural dimensions. But it is evident from the bare inspection of this animal, that when full grown he could not exceed the size of an ordinary dog. This animal, however, is the most formidable, the most cruel, in a word, he is the tiger of the New World, where nature

seems to have contracted every kind of quadruped. Like the tiger, the jaguar lives on prey. But a light is sufficient to make him fly; and when his stomach is full, he so entirely loses all courage and vivacity that he runs before a single dog. He is neither nimble nor active but when pressed with hunger. The savages who are naturally poltroons, are afraid to encounter him. They alledge that he prefers them to the Europeans, whom he never attacks. The leopard is likewise said to prefer the blacks to the whites, whom he is supposed to distinguish by the smell, and attacks them during the night as well as the day.

[In the province of Bamba, in the kingdom of Congou, there are tigers which never attack white men, but often rush upon the negroes: when a negroe and a white man are sleeping near each other, these animals run with fury upon the negro without injuring the white.]

Almost all the authors who have written the history of the New World mention this animal; some under the name of the *tiger* or *leopard*, others under the names given them in Brasil, Mexico, &c. Piso and Marcgrave, who first described him fully, called him *jaguara*, instead of *janouara*, his Brasilian name. They have also mentioned another animal of the same genus, and perhaps of the same species, under the name of *jaguarette*. Like these two authors, we have distinguished the jaguar from the jaguarette; because they appear to be animals of a different species. However, as we have seen one of these animals only, we cannot determine whether they are two distinct, or a variety of the same species. Piso and Marcgrave remark, that the jaguarette is distinguished from the jaguar by having shorter, more bright, and differently coloured hair, which is black, variegated with spots of a still deeper black. But in every other particular he resembles the jaguar so strongly in the figure of his body, manners, and temper, that he may still be only a variety of the same species; especially as Piso informs us, that in the jaguar the ground-colour of the hair and that of the spots vary in different individuals of this species. He says, that some are marked with black, and others with red or yellow spots: and with regard to the difference of gray, yellow, or black colours, the same thing takes place in other species of animals. There are black wolves, black foxes, black squirrels, &c. If such variations are rarer among wild than domestic animals, the phænomenon must be ascribed to the former being liable to fewer accidents which can produce such changes. As the life of the former is more uniform, their food less various, and their liberty greater than those of the latter, their nature must likewise be more constant, or less subject to accidental alterations in colour.

[In Brasil there is a rapacious animal which the savages call *janou-ara*, and has limbs nearly as high as those of the greyhound; but he has great whiskers and a beautiful skin, variegated like that of the ounce, whom he very much resembles in every other respect. The janouar is a kind of ounce, as large as an English bull-dog, with a fine spotted skin. The janouara of Brasil lives on prey only. He is of the stature of a greyhound, and his skin is spotted.]

The jaguar is found in Brasil, in Paraguay, Tucuman, Guiana, in the country of the Amazons, in Mexico, and in all the regions of South America. It is however more rare in Cayenne than the couguar, which has been called the red tiger; and the jaguar is not now so common in Brasil, which is its native country, as formerly. A price has been set on his head; numbers of this species have accordingly been destroyed; and the rest have retired from the coasts into the most desert parts of the country. The jaguarette has always been less common, or at least has kept at a greater distance from the habitations of men; and the few travellers who mention this animal seem only to copy Marcgrave and Piso.

THE JAGUAR OF NEW SPAIN.

In the month of June 1775, a female jaguar was sent to M. Le Brun from New Spain. It was very young; for all its teeth had not yet appeared, and it has since grown larger at Chaillot, where M. de Seve made a drawing of it in the beginning of October. We suppose it to be about nine or ten months old. His length, from the muzzle to the anus, was one foot eleven inches, and the height of his hind train from thirteen to fourteen inches. The jaguar described in the original work was two feet five inches four lines long, and the height of the hind train one foot four inches nine lines: but it was two years of age. Though belonging to different countries there is a great similarity between these two animals. The differences in the form of the spots seem to be individual varieties only. The iris is of a brown colour inclining to green; the edges of the eyes are black, with a white band both above and below. The colour of the head is yellow blended with gray, which is also the ground-colour of the spots; and the latter are bordered with black bands. These spots and bands are grounded on a dirty reddish white colour, inclining more or less to gray. The ears are black, with a very large white spot on their external part. The tail is long and well covered with hair.

THE JAGUAR OF GUIANA.

M. Sonini de Manoncour has made some excellent remarks on the jaguars of Guiana, which I shall here transcribe.

'The hair of the young jaguar,' says he, 'is not 'crisped, as M. de Buffon alledges. I have seen young 'jaguars with hair as smooth as that of adults. This

'observation has been confirmed by the most experienced hunters. With regard to their size, instead of equalling only, as M. de Buffon remarks, that of an ordinary dog, I have had two skins, which I was assured belonged to subjects of two or three years old, and one of them measured near five feet from the muzzle to the tail, which was two feet long. I have myself seen in the forests of Guiana tracks of these animals, which induced me, as well as M. de la Condamine, to think, that the American animals called tigers were as large as those of Africa. I even think, that except the true or royal tiger, the American tiger is the largest animal to which this appellation is given; since, according to M. de Buffon, the panther, which is the largest of these animals, exceeds not, when full grown, five or six feet in length; and it is certain that there are quadrupeds of this kind which greatly surpass these dimensions. The colour of the jaguar varies with age. When young he is of a very deep yellow, approaching to red or even brown. This colour brightens in proportion as the animal increases in years.

'The jaguar is not that indolent animal he has been represented by some travellers, whom M. de Buffon has copied. Instead of being afraid of dogs he springs upon them wherever he meets them. He makes great havock among the flocks. Those which inhabit the deserts of Guiana are even formidable to men. In a journey I made through these great forests, we were tormented two nights successively by a jaguar, notwithstanding a large fire which was kept perpetually blazing. He roamed continually round us; and we found it impossible to shoot him; for we no sooner aimed at him than he disappeared in a moment, then returned on the other side, and in this manner kept us in perpetual alarm. Notwithstanding all our vigilance we could never shoot him. He continued these manœuvres during two complete nights. He returned on the third: but seemingly disgusted by not obtaining his end, and perceiving that we had augmented our fire, which he was afraid to approach too near, he left us with dreadful howlings. His cry, *hou, hou*, is somewhat plaintive, grave, and strong, like that of the ox.

'With regard to the supposed predilection of the jaguar to the natives of the country, rather than to the negroes or whites, I suspect strongly that it is fabulous. I found this notion established at Cayenne: but I travelled along with savages through places where the largest tigers are common, and never discovered that they entertained any remarkable degree of terror at these animals. Like us they suspended their hammocks on trees, removed to a certain distance from us, and contented themselves with kindling a small fire, which frequently went out in the course of the night. These savages however were inhabitants of the interior parts of the country, and consequently knew the danger they had to apprehend. I can assure you, that they took no precautions, and appeared to be very little affected, though surrounded with these animals.'

Here I cannot help remarking, that this last fact proves that these last animals are not very dangerous, at least to men.

'The flesh of the jaguar is not good to eat. He combats with advantage all the quadrupeds of the New Continent, who fly from him with terror. The ant-eater, though he has no teeth to defend himself, is the most cruel enemy the jaguars have to encounter. As soon as the jaguar attacks the ant-eater, it lies down on its back, and seizes and suffocates him with its long claws.

THE COUGUAR.

THE couguar or brown cat has a very little head, small pointed ears, large eyes, a white chin, and the back, neck, rump, and sides, of a pale brownish red colour, mixed with dusky hairs. The breast, belly, and inside of the legs, are cinereous. The hair on the belly is long; the tail is dusky and ferruginous, but black at the tip. The teeth are of a vast size, and the claws are white, the outmost one of the fore feet being much longer than the others. It is long bodied, and high on its legs. The length from nose to tail is five feet three inches, and that of the tail two feet eight.

The couguar is as long, but not so thick as the jaguar; his legs are also longer, and he has more the shape of a greyhound. His head is small, his tail long, and his hair of nearly a uniform colour, being of a lively red, mixed with a little tincture of black, especially on the back. He has no spots like those of the tiger, the leopard, the ounce, and the panther. His chin, throat, and all the inferior parts of his body, are whitish. Though weaker he is equally ferocious, and perhaps more cruel than the jaguar. He appears to be still more rapacious, for he devours his prey without tearing it in pieces. As soon as he seizes an animal, he kills, sucks, and eats it successively, and never quits it till he is fully gorged.

These animals are very common in Guiana. Great numbers of them were formerly seen swimming from the continent to the island of Cayenne, in order to devour the flocks. They were at first a great scourge to the colony; but by hunting and destroying them they have gradually retired to a distance from the more cultivated parts of the country. They are found in Brasil, Paraguay, and the Amazon country; and it is probable, that the animal mentioned by some travellers under the name of *ocorome* is the same with the couguar, as well as the Iroquois animal, which has been regarded as a tiger, though he is neither spotted like the panther, nor marked with long bands like the tiger.

The couguars, by the lightness of their body, and the length of their limbs, should be more swift, and climb trees with greater facility than the jaguar. When gorged with prey they are both equally indolent and cowardly. They seldom attack men unless they find them sleeping. When men pass the night in the woods the kindling a fire is sufficient to prevent the approach of these animals. They delight in the shades of large forests. They conceal themselves in the thickets, or even in a bushy tree, from which they dart upon animals as they pass. Though they live on prey only, and drink blood oftener than water, their flesh is said to be very good. Piso says, that it is as good as veal, and others compare it to mutton. I can hardly believe that the flesh of this animal is good, especially as Desmarchais affirms, that the skin is the only part of him which is valuable, and that his flesh is generally lean, and of a disagreeable flavour.

THE COUGUAR OF PENSYLVANIA.

The jaguar, as well as the couguar, inhabits the warmest regions of South America. But there is another species of couguar (of which we have given a figure) found in the temperate climates of North America, as on the mountains of Carolina, Georgia, Pensylvania, and the adjacent provinces. The drawing of this couguar was sent me from England by the late Mr. Colinson, with the following description: if it is exact, this couguar must differ greatly from the common kind.

'The couguar of Pensylvania,' says Mr. Colinson, 'differs much from the couguar of Cayenne (above described). His limbs are shorter, his body much longer, his tail is also three or four inches longer. But in the colour of the hair, and the form of the head and ears, they have a perfect resemblance to each other. The couguar of Pensylvania,' adds Mr. Colinson, 'is an animal remarkable for thinness and length of body, shortness of legs, and length of tail. The length of the body, from the muzzle to the anus, is five feet four inches; and that of the tail is two feet six inches. The fore legs are one foot long, and the hind legs one foot three inches. The height of the body before is one foot nine inches, and one foot ten inches behind. The circumference of the thickest part of the body is two feet three inches.'

Mr. Edwards, who for skill in the art of drawing and knowledge of natural history merits the applauses of all lovers of science, sent me some engravings, which corresponded with the drawing communicated by Mr. Colinson.

THE BLACK COUGUAR.

M. de la Borde, king's physician at Cayenne, informs me, that in the continent there are three species of rapacious animals; that the first is the jaguar, which is called the tiger; that the second is the couguar, called the red tiger, on account of the uniform redness of his hair; that the jaguar is of the size of a large bull-dog, and weighs about 200 pounds; that the couguar is smaller, less dangerous, and not so frequent in the neighbourhood of Cayenne as the jaguar; and that both these animals take six years in acquiring their full growth. He adds, that there is a third species in these countries, called the black tiger.

'The head,' says M. de la Borde, 'is pretty similar to that of the common couguar; but the animal has long black hair, and likewise a long tail and strong whiskers. He weighs not above forty pounds. The female brings forth her young in the hollows of old trees.'

[To this description we shall add that given by Mr. Pennant, which is more accurate, though somewhat different from that communicated by M. de la Borde to M. de Buffon.

'Black tiger or cat, with the head black, sides, fore part of the legs, and the tail, covered with short and very glossy hairs, of a dusky colour, sometimes spotted with black, but generally plain: upper lips white: at the corner of the mouth a black spot: long hairs above each eye, and long whiskers on the upper lip: lower lip, throat, belly, and the inside of the legs whitish, or very pale ash-colour: paws white: ears pointed: grows to the size of a heifer of a year old: has vast strength in its limbs. Inhabits Brasil and Guiana: is a cruel and fierce beast; much dreaded by the Indians; but happily is a scarce species.'

This description was taken from two black couguars which were shown in London some years ago.]

This black couguar may be the same animal which Piso and Marcgrave call the *jaguarette* or *jaguar with black hair*, and which no other traveller has mentioned under the name of *jaguarette*. I only find, in a note of M. Sonini de Manoncour, that the jaguarette is called the black tiger at Cayenne, and that he is of a different species from the jaguar, being smaller, and thinner in

the body. This animal is fierce and rapacious; but he is very rare in the neighbourhood of Cayenne.

'The jaguars and couguars,' continues M. de la Borde, 'are very common in all the lands which border on the 'river of the Amazons, as far as Saint Martha. Their 'skin is so tender as to be easily pierced by the simple 'arrows of the Indians. Besides, all these animals are 'not absolutely fond of carnage; for a single prey 'always satisfies them. They go generally alone; but 'when the females are in season, sometimes two or three 'of them are seen together.

'When pressed with hunger they attack cows and 'oxen. They spring upon the back of an ox, fix the 'claws of their left foot upon his neck, and when he falls 'down they tear him in pieces; and after opening his 'breast and belly to glut themselves with blood, they 'trail portions of his flesh into the wood. They then 'cover the remainder of the carcase with branches 'of trees, and remove not to any great distance. But 'whenever the flesh begins to corrupt, they eat no more 'of it. Sometimes they conceal themselves in trees, 'and dart down upon passing animals. They likewise 'follow the flocks of wild hogs, and seize the stragglers. 'But if ever they allow themselves to be surrounded by 'these animals, they have no safety except in a precipi-'tate retreat.

'But neither the jaguars nor couguars are absolutely 'ferocious: they never attack men unless they feel 'themselves wounded. But they despise the assaults 'of dogs, which they often seize in the neighbourhood 'of houses. When pursued by such a number of dogs 'as obliges them to fly, they take refuge in the trees. 'These animals often roam about the margins of the sea, 'and eat the eggs deposited there by the turtles. They 'likewise eat *caimans* or alligators, lizards, fishes, and 'sometimes the buds and tender leaves of the Indian fig. 'They are excellent swimmers, and traverse the largest 'rivers. In taking the *caiman*, they lie down on their 'belly at the edge of the river, strike the water to make a 'noise, and attract the attention of the *caiman*, who soon 'approaches, and raises his head above the water, upon 'which the jaguar instantly makes his deadly spring, 'and after killing the animal drags him off to a distance, 'in order to devour him at leisure.

'The Indians say that the jaguars decoy the agouti 'by counterfeiting his cry. It is likewise said, that they 'attract the caiman by a cry similar to that of a young 'dog, or like that of a man who coughs, which is still 'more difficult to believe.

'When these animals are in season they set up dread-'ful roarings, which are heard at great distances. They 'commonly bring forth but one at a time, which they 'deposit in the large trunks of corrupted trees. At 'Cayenne they eat the flesh of these animals, which 'when young is as white as that of a rabbit.'

The couguar when brought into captivity is almost equally gentle as the other domestic animals.

'I have seen,' says the author of *Les Recherches sur les Americains*, 'a living couguar at the house of Ducos, 'a keeper of wild beasts; he was as peaceable as a dog, 'and of greater size than the largest kind of dogs. He 'stands high on his legs, which renders him nimble and 'alert. His canine teeth are very large, and conical. 'He was neither disarmed nor muzzled; and he was 'coducted by a leash. He allowed himself to be caressed 'with the hand. I have seen boys mount him, and ride 'a-straddle on his back. The name of the *paltroon tiger* 'has been given to him with propriety.'

THE LYNX.

THE lynx has a short tail, black at the end, pale yellow eyes, and long full hair under the chin. The hair on the body is long and soft, of a cinereous colour, tinged with red, and marked with dusky spots, more or less distinct in different subjects; in some they are hardly visible. The belly is whitish. The ears are erect, and tufted with long black hairs, which is the character of the different kinds of lynxes. The legs and feet are very thick and strong. The length of the skin of a Russian lynx, from nose to tail, was four feet six inches, and that of the tail only six inches. They sometimes vary in their colour. The *irbys* from Lake Balckash, or the *kattle* of the Swedes, is whitish, spotted with black, and larger than the common kind. This variety is called by the Germans *wolf-lucks*, and *kalb-lucks*, on account of its size.

The gentlemen of the Academy of Sciences have given a very good description of the lynx, and have discussed with much critical acuteness the facts and appellations relating to this animal which occur in the writings of the ancients. They have shown that the lynx of Ælian is the same animal which they have described and dissected, and they censure with propriety those who have mistaken it for the *thos* of Aristotle. This discussion is intermixed with remarks and reflections which are pertinent and interesting. After clearing their ground with

so much address we wish they had retained the true name lynx, instead of substituting that of *lupus cervarius*. They appear likewise, after making a proper distinction with Oppian, of two different species or races of the lynx, the one large, which hunts and attacks the fallow deer and the stag, and the other smaller, which hunts the hare only, to have blended the two together, namely, the spotted lynx, which is commonly found in the northern countries, and the Levant or Barbary lynx, whose hair is of a uniform colour. We have seen both these animals alive. They resemble each other in many respects. They have both two long black pencils of hair on the tips of their ears. This character, under which Ælian first pointed out the lynx, is peculiar to these two animals, and probably led the gentlemen of the Academy to regard them as constituting but one species. But independent of the difference of colour and spots of the hair, the following history and description will render it extremely probable that they are distinct species.

M. Klein says, that the most beautiful lynx is a native of Africa and Asia, and particularly of Persia; that he saw one at Dresden that had been brought from Africa, which was finely spotted, and stood high on its limbs; that those of Europe, especially of Prussia and the northern regions, are less handsome; that they have little or no white, but are rather red, with blotched and ill-defined spots, &c. I choose not to deny absolutely what M. Klein has here advanced. I have never seen it mentioned however by any other author, that the lynx is a native of the warm countries of Asia and Africa. Kolbe is the only writer who affirms that the lynx is common at the Cape of Good Hope, and perfectly resembles that of Brandenburgh and the north of Europe. But I have discovered so many errors in the works of this author, that I give no credit to his testimony unless when it coincides with that of others. Now all travellers agree in having seen the spotted lynx in the north of Germany, in Lithuania, Muscovy, Siberia, Canada, and other northern regions of both continents. But no author, whose writings I have perused, asserts that the lynx is to be met with in the warm regions of Africa or Asia. The lynx of the Levant, of Barbary, of Arabia, and other hot climates, is, as formerly remarked, of one uniform colour, without any spots: he is not therefore the lynx of M. Klein, which was finely spotted, nor that of Kolbe, which perfectly resembled that of Brandenburg. It would be a difficult task to reconcile the evidence of these authors with what we learn from other sources. The lynx is unquestionably more common in cold than in temperate climates, and he is at least very rare in warm countries. He was indeed known to the Greeks and Romans. But from this circumstance it is not to be inferred, that he was brought from Africa or the southern provinces of Asia. Pliny, on the contrary, says, that the first of these animals which appeared in Rome were sent from Gaul in the days of Pompey. At present there are none in France, unless perhaps in the Alps or Pyrenees. Under the name of Gaul, however, the Romans comprehended a great part of the north; and besides, France is now much warmer than it was in the time of the Romans. The finest skins of the lynx come from Siberia, under the name of *loup-cervier*, and from Canada, under that of *chat-cervier*, because these animals, like all others, are smaller in the New than in the Old Continent; in the former they are compared to the wolf, in the latter to the cat.

The following circumstances might deceive M. Klein, and even men of greater ability: 1. The ancients say, that India furnished lynxes to the god Bacchus; 2. Pliny has placed the lynx in Æthiopia, and says, that the hide and claws were prepared at Carpathos, now Scarpantho, or Zerpanto, an island in the Mediterranean between Rhodes and Candia; 3. Gesner has made a particular article of the Asiatic or African lynx, which contains the following extract of a letter from Baron de Balicze: 'You have not mentioned,' says the Baron to Gesner, 'in your history of animals, the Indian or African lynx. 'As Pliny has spoken of it, the authority of so great a 'man induced me to send you a drawing of this animal, 'that you may have an opportunity of describing it. 'This drawing was made at Constantinople. The animal 'is very different from the German lynx, being larger, 'having rougher and shorter hair,' &c. Gesner, without making any reflections on this letter, contents himself with relating the substance of it, and informing us, in a parenthesis, that the drawing never arrived.

To prevent similar mistakes, let us observe, 1. That the poets and painters have yoked the chariot of Bacchus with tigers, panthers, or lynxes, according to their own fancy, or rather because all ferocious animals with spotted skins were equally consecrated to this god. 2. That it is the word lynx which creates all this ambiguity; for it is evident, by comparing different passages of Pliny with each other, that the Æthiopian animal he calls *lynx* is by no means the same with the *chaus* or *lupus cervarius*, which is a native of the northern regions; and that, by a similar misapplication of the name, the Baron de Balicze has been deceived, though he regards the Indian lynx as a different animal from the German *luchs* or our lynx. This African or Indian lynx, which he says was larger and more beautifully spotted than our lynx, was perhaps a kind of panther. Whatever may be in this last conjecture, it is plain that the lynx of which we are here treating exists not in warm climates, but is confined to the northern countries of the Old and New Continents. Olaus says, that this animal is common in the forests of the northern parts of Europe. Olearius makes the same remark when treating of Muscovy. Ro-

sinus Lentilius tells us, that the lynx is common in Courland and Lithuania, and that those of Cassubia, a province of Pomerania, are smaller and not so much spotted as those of Poland and Lithuania. Lastly, to these testimonies Paulus Jovius adds, that the finest skins of the lynx come from Siberia, and that they constitute a great article of trade at Ustivaga, a town six hundred miles distant from Moscow.

This animal which, as we have seen, prefers cold to temperate countries, is one of those that might pass from the one continent to the other by the lands to the north; and accordingly he is found in North America. Travellers have described him in a manner not to be misunderstood: besides, his skin is an article of commerce between America and Europe: the lynxes of Canada, as formerly remarked, are only smaller and whiter than those of Europe; and it is this difference of size that has procured to them the name of *cati-cervarii*, and induced the nomenclators to regard them as a distinct species. Without pronouncing decisively concerning this matter, the Canadian and Russian lynxes appear to be the same species; 1. Because the difference of size is not very considerable, being nearly proportioned to that which takes place in all the quadrupeds which are common to both continents. The wolves, the foxes, &c. of America, being less than those of Europe, the same phænomenon should be exhibited in the lynx. 2. Because these animals, even in the north of Europe, vary in size; and two kinds, a smaller and a larger, have been mentioned by authors. 3. Because they equally love cold climates, and being of the same dispositions, the same figure, and differing only in size and some shades of colour, these characters seem sufficient to authorise us to pronounce that they belong to the same species.

The lynx, of which the ancients said that his sight penetrated the most opaque bodies, and whose urine became a precious stone, called *lapis lyncurius*, is an animal equally fabulous as the qualities they have ascribed to him. This imaginary lynx has no other relation to the true lynx than the name. We must not, therefore, in imitation of most naturalists, attribute to the former, which is a real being, the qualities of this creature of imagination, the existence of which even Pliny himself seems not to believe; for he speaks of it as an extraordinary animal, and ranks it along with the sphynx, the pegasus, the unicorn, and other prodigies or monsters, brought forth in Æthiopia, a country of which the ancients had no knowledge.

Our lynx, though his sight cannot penetrate stone-walls, has brilliant eyes, a mild aspect, and an agreeable and sprightly air. His urine is not converted into precious stones; but he covers it with earth like the cats, to whom he has a great resemblance, and whose manners and love of cleanliness are the same. He has nothing in common with the wolf but a kind of howling, which, being heard at a great distance, often deceives the hunters, and makes them imagine they are pursuing a wolf. This alone is perhaps sufficient to account for the name wolf, which has been given to him, and to which, to distingush him from the real wolf, the hunters have added the epithet *cervarius*, because he attacks the stag; or rather because his skin is variegated with spots like that of the young stag. The lynx is smaller, and stands lower on his legs than the wolf. He is generally about the size of a fox. He differs from the panther and ounce by the following characters: his hair is longer, and his spots less lively, and not so well defined. His ears are much longer, and terminate in a pencil of black hairs. His tail is much shorter, and black at the extremity. The circle of his eyes is white, and his aspect is softer and less ferocious. The skin of the male is more spotted than that of the female. He does not run out like the wolf, but walks and springs like the cat. He lives by hunting, and pursues his prey to the tops of the highest trees. The wild cats, the pine weasels, the ermines, and the squirrels, are unable to escape him. He likewise seizes birds; and watches the approach of stags, fallow-deer, hares, &c. darts down upon them, seizes them by the throat, sucks their blood, and opens their skull to devour their brain; after which he often abandons them, and goes in quest of a fresh game. He seldom returns to his prey, which is the reason why the lynx has been said to have a very bad memory. The colour of his hair changes with the climate and the season. The winter furs are more beautiful and richer than those of summer. His flesh, like that of all carnivorous animals, is not good.

SUPPLEMENT.

The figure of a Canadian lynx, according to an excellent preparation in the royal cabinet, is only two feet three inches long from the tip of the nose to the origin of the tail, and from twelve to thirteen inches high. The body is covered with long grayish hair, mixed with white, and striped with yellow. The spots are more or less black. The head is grayish, blended with white and bright yellow hairs, and striped, as it were, with black in some parts. The tip of the nose, as well as the margin of the under jaw, is black. The whiskers are white, and about three inches long. The ears are two inches three lines high, garnished in the inside with large white hairs, and with yellowish hairs on the edges. The outer side of the ear is covered with mouse-coloured hair, and the external margins are black. At the extremity of each ear there is a large thin pencil of black hairs, seven lines high. The tail, which is thick, short, and well furnished with hair, is only three inches nine lines in length; from the extremity to the middle it is black, and afterwards of

a reddish white colour. The under part of the belly, the hind legs, the inside of the fore legs, and the feet, are of a dirty white. The claws are white, and about six lines long. This lynx has a great resemblance, both in the spots and nature of the hair, to that whose figure we have given; but it differs in the length of the tail and the pencils on the ears. The Canadian lynx therefore may be regarded as a variety very different from the lynx of the Old Continent. It may even be said to make a near approach to the caracal, by the pencils on its ears; but it differs from the caracal still more than from the lynx, by the length of the tail and the colour of the hair. Besides the caracal is only found in warm countries; but the lynx prefers cold climates. The pencil of hair upon the tips of the ears, which is regarded as a distinctive character, is only accidental, and appears in animals of this species, and even in the domestic and wild cats. Of this we have given an example in the supplement to the article *cat*. Hence we persist in believing that the American lynx is only a variety of the European species.

The Norwegian lynx, described by Pontoppidan, is white, or of a bright gray colour, interspersed with deep spots. Its claws, like those of other lynxes, resemble the claws of cats. He elevates his back, and springs upon his prey with equal quickness and address. When attacked by a dog, he lies down upon his back, and repels the enemy by repeated strokes of his claws. This author adds, that there are in Norway four species; that some of them approach the figure of the wolf, others that of the fox, others that of the cat, and lastly, that there are others whose head resembles that of a colt. This last fact, which I believe to be false, creates the most violent suspicion with regard to all the rest. The author adds some articles which are more probable.

'The lynx,' says he, 'does not go about the country, 'but conceals himself in woods and caverns. He makes 'his retreat deep and winding, from which he can be 'expelled by fire and smoke only. His sight is piercing, 'and he spies his prey at a very great distance. He often 'eats no more of a sheep or a goat than the brain, the 'liver, and the intestines; and he digs under the doors 'in order to gain admission into the sheepfolds.

The species of the lynx is not only spread over Europe but all the northern provinces of Asia. In Tartary they are called *chulon* or *chelason*. Their skins are highly valued, and, though very common, sell equally dear in Norway, Russia, and as far as China, where they are much used for muffs and other furs.

That the pencils of hair on the tips of the ears form not a distinctive character appears from this fact, that there exists in the district of Alger, called Constantine, a species of caracal, without these pencils, and which resembles the lynx, except that its tail is longer. The colour of its hair is reddish, with longitudinal black stripes from the neck to the tail, detached spots on the flanks disposed in the same direction, a black half circle on the top of the fore legs, and a band of rough hair on the four legs, extending from the extremity of the foot to above the heel; and this hair inclines upward instead of downward, like the hair of every other part of the body

THE CARACAL

THE Persian cat, with a lengthened face and a small head, has long slender ears, terminated with a long tuft of black hairs. The inside and bottom of the ears and nose are white. The eyes are small; the upper part of the body is of a pale reddish brown colour, and the tail is rather darker. The belly and breast are whitish; the limbs are strong, and pretty long. The tail is about half the length of the body.

Though the caracal resembles the lynx in size, figure, aspect, and the pencil of black hair on the tips of the ears, we are of opinion, from the disparities between these two animals, that they belong to different species. The caracal is not spotted like the lynx; his hair is rougher and shorter; his tail is longer, and of a uniform colour; his muzzle is also more lengthened; his aspect is less mild, and his disposition more ferocious. The lynx inhabits cold or temperate climates only; but the caracal is never found except in warm countries. It is from these differences of disposition and climate that we have referred them to different species, as well as from the inspection and comparison of the two animals, both of which we have examined and drawn from the life.

This animal is common in Barbary, in Arabia, and in all the countries inhabited by the lion, the panther, and the ounce. Like them he lives on prey; but being smaller and weaker, it is with difficulty he procures subsistence; for he is generally obliged to be contented with what they leave. He keeps at a distance from the panther, because that animal exercises its cruelties after being fully gorged with prey. But he follows the lion, which after a full repast never injures any creature. The

caracal feeds upon the offals of the lion's table, and sometimes follows or goes before him, at no great distance, having nothing to apprehend from his rage; because he is unable, like the panther, to pursue the caracal to the tops of the tallest trees. For all these reasons the caracal has been called the lion's guide or provider. The latter, whose smell is not acute, employs the former to scent animals at a distance, and rewards him with a part of the spoil.

[The karacoulacs are animals somewhat larger than cats, and of the same make. They have black ears, nearly half a foot long, and from this circumstance they derive their name, which signifies *black ear*. According to the opinion of the natives they serve as pioneers to the lion: for they go a little before, explore those places where prey is to be expected, and are rewarded with a share. When this animal gives the alarm to the lion, his cry resembles that of one person to another.—*Voy. de Thevenot.*

I saw an animal in an iron cage which the Arabs called the lion's guide. It has so strong a resemblance to a cat, that it has been called the cat of Syria; and I saw another of them at Florence which went under the same name. He is so fierce, that if any person attempts to take meat from him he becomes perfectly furious, and if not appeased springs instantly upon the spoiler. There are small tufts of hair on the summits of his ears; and he is called the lion's guide, because the latter is said to be deficient in scent. But when attended by the caracal, which has a very acute nose, he follows his prey, and rewards his conductor with a share.—*Voy. d'Orient, du Pere Philippe.*

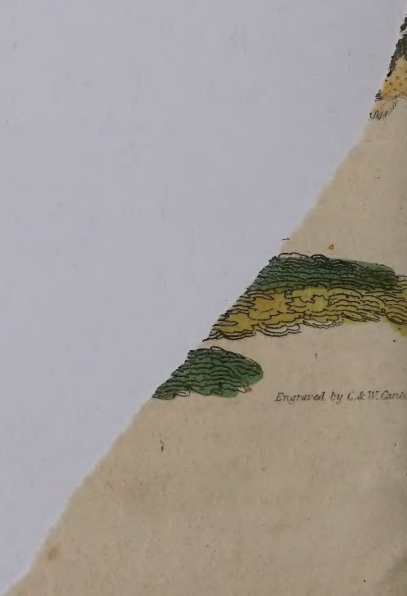
The *gat el challah*, *siyah-gush*, or *karah-kulak*, i. e. *the black cat*, or *black eared cat*, as the Arabic, Persian, and Turkish names signify, is of the bigness and shape of a cat of the largest size. The body is of a reddish brown; the belly of a light colour, and sometimes spotted; the chops are black, the ears of a deep gray, with the tips of them distinguished by small tufts of black stiff hair, as in the lynx. The figure given of this animal by Charleton is not so full in the chops as the Barbary siyah-gush.—*Shaw's Travels.*

The figure given by Charleton does not represent the hair properly; and the head, which is bald, is deprived of its roundness. However, the siyah-gush of Charleton, and that of Barbary, mentioned by Dr. Shaw, belong to the same species with our caracal.]

The caracal is about the size of a fox, but much stronger and more ferocious. He has been known to attack and instantly tear to pieces a middle-sized dog, which defended itself as long as it was able. He is extremely difficult to tame. However, when taken young, and reared with care, he may be trained to hunting, an employment of which he is naturally fond, and in which he is very successful, especially if he is never let loose upon any animal that is not his inferior in strength; for he loses courage as soon as he perceives real danger. In India he is employed for catching hares, rabbits, and even large birds, whom he surprises and seizes with singular address.

SUPPLEMENT.

I mentioned under the article *caracal*, that the word *gat el-challah* signified *the black eared cat*. Mr. Bruce assures me that it means the *cat of the desert*. In that part of Nubia formerly called the Isle of Meroe he saw a caracal which differed in some respects from that of Barbary. The face of the Nubian caracal is rounder, the ears black on the outside, but interspersed with silver-coloured hairs. He has the mule-cross on his withers, like most of the Barbary caracals. On the breast, belly, and inside of the thighs, there are small bright yellow spots, and not blackish brown, as in the Barbary caracal. These are only slight varieties, the number of which might be still augmented; for we find in Barbary, or rather in Lybia, near the ancient Capsa, a caracal with white, instead of black ears. The pencils of these white-eared caracals, are thin, short, and black. They have a white tail, the extremity of which is surrounded with four black rings, and four black patches on the hind part of each leg, like the Nubian caracal. They are also smaller than the other caracals, not exceeding the size of a domestic cat. The ears are white within, and covered on the outside with bushy hair, of a lively red colour. If this difference in size were constant, it might be alledged that there are two species of caracals in Barbary, the one large with black ears and long pencils, the other smaller with white ears and very short pencils. It appears likewise, that these animals, which differ so greatly in their ears, are equally diversified in the form and length of the tail, as well as in the height of the legs; for Mr. Edwards has sent us the figure of a caracal from Bengal, whose tail and limbs are vastly longer than those of the common kind.



THE HYÆNA.

THE hyæna has long, sharp pointed, naked ears, an upright mane, high shoulders, and the fore legs higher than the hind legs. The hair on the body is coarse, rough, pretty long, and of an ash-colour, marked with long black stripes from the back downwards, and others cross the legs. The tail is very full of hair, sometimes plain, and sometimes barred with black. His size is that of a large dog; but he is very strong made.

Though Aristotle has left us two characters by which alone this animal is easily distinguished from all others; yet travellers and naturalists have confounded the hyæna with no less than four different species, namely, the jackal, the glutton, the civet, and the baboon. They are carnivorous, and ferocious, like the hyæna, and each of them has some resemblance to him which might give rise to the mistake. The jackal inhabits the same countries, and like the hyæna has nearly the form of a wolf, feeds upon dead carcasses, and digs them out of the sepulchres. The glutton is equally voracious, has the same appetite for putrified flesh, the same instinct of digging the dead out of their graves; and though he lives in a different climate, and his figure is very different from that of the hyæna, this conformity of natural dispositions was sufficient to make authors confound them together. The civet is found in the same countries, and like the hyæna has long hair along the back, and a particular fissure or orifice. These singular characters, which belong to no other animals, misled Belon into the notion that the civet was the hyæna of the ancients. The baboon has still less resemblance to the hyæna than the other three; for it has hands and feet like those of a man or a monkey. Naturalists therefore could be deceived by the name only: in Barbary the hyæna, according to Doctor Shaw, is called *dubbah*, and the baboon, according to Marmol and Leo Africanus, is called *dabuh;* and as the baboon is found in the same climates, digs the earth, and is nearly of the same form with the hyæna, these affinities first deceived travellers, and naturalists copied the blunder without sufficient examination. Even those who have clearly distinguished these two animals have given to the hyæna the name of *dabuh*, which belongs to the baboon. Hence the hyæna is not the *dabuh* of the Arabians, nor the *jesef* or *sesef* of the Africans, as we are told by naturalists. Neither should he be confounded with the *deeb* of Barbary. But to prevent all future confusion arising from names, we shall in a few words give a detail of the researches we have made with regard to these animals.

Aristotle employs the two names *hyæna* and *glanus*. To be convinced that these appellations denote the same animal, we have only to compare the passages where they occur. The ancient Latins preserved the name *hyæna*, and never used that of *glanus*. Among the modern Latins we find the words *ganus* or *gannus*, and *belbus*, substituted for *hyæna*. According to Rasis the Arabians called the hyæna *kabo* or *zabo*, names seemingly derived from the word *zeeb*, which in their language signifies a wolf. In Barbary the hyæna is called *dubbah*, as appears from the description given of it by Dr. Shaw. In Turkey the hyæna, according to Nieremberg, is named *zirtlum*, in Persia *kaftaar*, according to Kæmpfer, and *castar*, according to Pietro della Valle. These are all the appellations which can with propriety be referred to the hyæna. It is probable, however, that the *lycaon* and *crocuta* of India and Æthiopia, mentioned by the ancients, are no other than the hyæna. Porphyry says expressly, that the Indian *crocuta* is the hyæna of the Greeks. Indeed all that the ancients have said, whether true or fabulous, concerning the *lycaon* and *crocuta*, apply to the hyæna. But we shall postpone all farther conjectures on this subject till we come to treat of fabulous animals, and the relations they have with real ones.

The panther of the Greeks, the *lupus canarius* of Gaza, and the *lupus Armenius* of the Arabians and modern Latins, seem to be the same animal, namely, the jackal, which Pollux says is called *cical* by the Turks, or *thacal*, according to Spoon and Wheeler: the modern Greeks call it *zachalia*, the Persians *siechal* or *schachal*, and the Moors of Barbary *deeb* or *jackal*. We shall retain the name jackal, because it has been adopted by some travellers, and content ourselves with remarking in this place, that he differs from the hyæna not only in size, figure, and colour, but likewise in his manners; for the jackals commonly go in troops, and the hyæna is a solitary animal. Our modern nomenclators, in imitation of Kæmpfer, call the jackal *lupus aureus*, because his hair is of a lively yellow colour.

The jackal, as we have seen, is an animal very different from the hyæna as well as from the glutton, which last is peculiar to the northern regions of Lapland, Russia, and Siberia: it is even unknown in the temperate climates, and consequently could never inhabit Arabia and the other warm countries frequented by the hyæna. Besides, the figure of the glutton resembles that of a very large badger; his limbs are so short that his belly nearly reaches to the ground; he has five toes both on the fore and hind feet; no mane, and black hair over all the body, except sometimes a few brownish yellow hairs on the flanks. In a word he possesses

nothing in common with the hyæna but his voracity. He was likewise unknown to the ancients, who had not penetrated far into the northern regions of Europe. Olaus is the first author who mentions this animal, which he has called *gulo* on account of its gluttony. He was afterwards denominated *rosomak* in the Sclavonian language, and *jerff* or *wildfras* in the German. The French travellers have called him *glouton*. In this species there are varieties, as well as in that of the jackal, which shall be pointed out in the particular history of those animals. But these varieties, instead of making him approach nearer the hyæna, remove the two species to a still greater distance.

The civet has nothing in common with the hyæna except the fissure or sac under the tail, and the mane along the neck and spine. Its difference from the hyæna in the figure and size of the body being one half smaller. Its ears are short and covered with hair, while those of the hyæna are long and naked. Besides, it has shorter limbs, and five toes on each foot; but the legs of the hyæna are long, and he has only four toes on each foot. Neither does the civet dig the earth in quest of dead bodies. It is therefore extremely easy to distinguish these animals.

With regard to the baboon, which is the *papio* of the Latins, he seems to have been mistaken for the hyæna by an ambiguity of names, to which a passage of Leo Africanus, copied by Marmol, seems to have given rise. 'The *dabuh*,' say these two authors, 'is of the size and 'figure of the wolf, and tears dead bodies from the 'sepulchres.' The similarity of the name *dabuh* with *dubbah*, which last denotes the hyæna, joined to the avidity for dead carcases common to the *dabuh* and *dubbah*, have made them be mistaken for the same animal, though it be expressly mentioned in the very passages we have quoted, that the *dabuh* has hands and feet like those of a man, which corresponds with the baboon, but is inapplicable to the hyæna.

By looking at Belon's figure of the *lupus marinus*, which Gesner has copied, this animal might be mistaken for the hyæna, because there is a considerable resemblance. But this description corresponds not with our hyæna; for he tells us, that the *lupus marinus* is an amphibious animal, which feeds on fishes, and has sometimes been seen on the coasts of the British ocean. Besides, Belon mentions none of the peculiar characters which distinguish the hyæna from all other quadrupeds. Belon, prepossessed perhaps with the notion that the civet was the hyæna of the ancients, has given the figure of the true hyæna under the name of the *lupus marinus*; for the characters of the hyæna are so singular that it is almost impossible to mistake him. He is perhaps the only quadruped that has four toes on each foot. Like the badger he has an orifice under the tail, which penetrates not into the body. He has long, straight, naked ears; a head shorter and more square than that of the wolf; but his legs, particularly the hind ones, are longer. His eyes are placed like those of a dog. The hair of his body and mane is of a dark grey colour, mixed with a little yellow and black, and transverse dusky undulations. He is of the size of a wolf, only his body is shorter and more compact.

This savage and solitary animal lives in the caverns of the mountains, in the clefts of rocks, or dens which he digs for himself in the earth. His disposition is extremely ferocious, and though taken young can never be tamed. Like the wolf he feeds on prey; but he is stronger and more daring. He sometimes attacks men, and rushes with fury upon cattle of all kinds. He follows the flocks, and often breaks down the doors of stables and the inclosures of the sheepfolds. His eyes sparkle in the dark; and he is said to see better in the night than in the day. All naturalists agree that his cry resembles the groanings of a man who vomits, or rather the lowing of a calf, according to Kæmpfer.

The hyæna defends himself against the lion, is not afraid of the panther, and attacks the ounce, which is not able to resist him. When prey fails he digs the earth with his feet, and tears out the dead bodies of animals and men, who, in the countries which he inhabits, are equally buried in the fields. He is found in almost all the warm climates of Africa and Asia; and the animal called *farasse* at Madagascar, which in figure resembles the wolf, but is larger, stronger, and more cruel, is perhaps the same with the hyæna.

A greater variety of absurd stories have been related concerning the hyæna than any other quadruped. The ancients gravely tell us, that the hyæna is alternately male and female; that when it brings forth, sucks, and rears its young, it continues to be a female during the whole year; but that the following year it resumes the functions of the male, and makes its companion submit to the lot of the female. This story, it is apparent, has no other foundation than the fissure under the tail, which is common to the male as well as the female, independent of the organs of generation peculiar to both sexes, which in the hyæna are similar to those of all other quadrupeds. The hyæna has been said to imitate the human voice, to remember the names of shepherds, to call upon, to fascinate, and to deprive them of the power of motion; and at the same time to terrify the shepherdesses, to make them run from and neglect their flocks, to render them frantic with love, &c. All this might happen without the hyæna! and I here stop, lest I should with Pliny incur the censure of delighting in compiling and relating ridiculous fables.

SUPPLEMENT.

In the year 1773 I saw a male hyæna at the fair of

St. Germain. The hyæna above described was perfectly ferocious; but this male, having been tamed when young, was remarkably gentle; for though his master often provoked him with a cudgel, in order to make him erect his mane, he instantly after seemed to forget the affront. He played with his keeper, who put his hand into the animal's mouth, without the least apprehension of danger. This hyæna was precisely of the same species with that whose description I have formerly given; and I have nothing to add to it except that the tail of this male was all white, without any mixture of other colours. He was somewhat larger than the first, being three feet two inches long from the extremity of the muzzle to the origin of the tail, and carried his head lower than is represented in the figure. His height was two feet three inches; and his hair was white, intermixed with streaks and spots of black, both on the body and legs.

In the south part of the island of Meroe there are hyænas much larger than those of Barbary. Their muzzle is longer, and has a great resemblance to that of a dog. This animal is so strong that he carries off a man to the distance of a league or two without stopping. His hair is coarse, browner than that of the other kind, and the transverse streaks are blacker. His mane erects not from the head, but from the tail. Mr. Bruce was the first who remarked of this hyæna, as well as that of Syria and Barbary, that when forced to fly they are lame of the left hind leg, which continues so remarkably for about a hundred paces, that the animal seems as if he would tumble down on his left side.

THE CIVET AND THE ZIBET.

THE civet has short rounded ears, sky blue eyes, a sharp nose, black at the point; the sides of the face, chin, breast, legs, and feet, are black; the rest of the face, and part of the sides of the neck, are white, tinged with yellow. From each ear three black stripes proceed, and end at the throat and shoulders. The back and sides are cinereous, tinged with yellow, and marked with large dusky spots disposed in rows. The hair is coarse, and that on the top of the body is longest, standing up like a mane. The tail is sometimes wholly black, and sometimes spotted near the base. The length from nose to tail is about two feet three inches, that of the tail is fourteen inches; and the body is pretty thick.

The zibet has short round ears, a sharp long nose, a pale cinereous face. The head and lower part of the neck are mixed with dirty white, brown, and black. The sides of the neck are marked with stripes of black, beginning near the ears and ending at the breast and shoulders. From the middle of the neck, along the ridge of the back, extends a black line, reaching some way up the tail; on each side are two others. The sides are spotted with ash-colour and black. The tail is barred with black and white; and the black bars are broader on the upper side than on the lower.

It is the opinion of most naturalists that the perfume called musk was furnished by one species of animal only. I have seen two of these animals, which, it must be allowed, have many essential relations, both in their external and internal structure; but they differ from each other by such a number of other characters as entitle them to be regarded as two distinct species. To the first we have preserved the ancient name of civet, and to the second we have given, for the sake of distinction, that of zibet. The civet appears to be the same with that described by the gentlemen of the Academy in the *Mem. pour servir a l'Histoire des Animaux*, by Caius in Gesner, and by Fabius Columna, who has given a figure of both male and female in the work of Jean Faber, which is at the end of that of Hernandes.

The second species, which I have called the zibet, seems to be the same animal with that described by M. de la Peyronnie, under the name of the musk animal. Both differ from the civet by the same characters; both want the mane or long hair on the spine; and both have annulated tails. But the civet has neither mane nor rings. It must be allowed, however, that our zibet and the musk animal of M. de la Peyronnie, have not such a perfect resemblance as to leave no doubt concerning the identity of their species. In the zibet the rings on the tail are larger than those of the musk animal. The former has not a double collar, and his tail is shorter in proportion to the length of his body. But these differences are slight, and appear to be accidental varieties only, to which the civet must be more liable than other wild animals, because he is kept in a domestic state in many parts of India and the Levant. It is certain however, that our zibet has a greater resemblance to the musk animal of M. de la Peyronnie than to the civet, and consequently the two former may be regarded as belonging to the same species; for we have no absolute certainty that the civet and zibet are not varieties

of the same species, because we are ignorant whether they can intermix and produce fertile individuals: and when we say that they seem to be different species, we only mean that the presumption is exceedingly strong, since it is founded on permanent differences in their characters, which generally distinguish real species from accidental varieties.

The animal we here call the civet is named *falanoue* in Madagascar, *nzime* or *nzfusi* in Congou, *kankan* in Æthiopia, and *kastor* in Guinea. We are certain that it is the civet of Guinea; for our subject was sent alive from Guinea to St. Domingo to one of our correspondents, who after feeding it some time killed it for the conveniency of carriage.

The zibet is probably the civet of Asia, of the East Indies, and of Arabia, where he is called zebet or zibet, an Arabian word, which signifies also the perfume of this animal. He differs from the civet in having a longer and thicker body, a thinner and flatter muzzle, which is somewhat concave on the upper part; while the muzzle of the civet is thicker, shorter, and a little convex. The ears of the former are also larger and more erect. His tail is longer, and better marked with annular spots, and his hair is shorter and softer. He has no mane or long hair on the neck and spine, no black spots under the eyes or on the cheeks, which are remarkable characters in the civet. Several travellers have suspected that there were two species of civets; but nobody has examined them so minutely as to furnish a distinct description. We have seen both, and after a careful comparison we think they are not only different species, but belong perhaps to different climates.

These animals have been called musk-cats or civet-cats, though they have nothing in common with the cat but agility of body. They rather resemble the fox, especially in the head. Their skin is marked with bands and spots, which have made them be mistaken for the panther when seen at a distance. But they differ from the panther in every other respect. There is an animal called the genet, which is spotted in the same manner, whose head is nearly of the same form, and which, like the civet, has a sac where an odoriferous liquor is secreted. But the genet is smaller than our civet. Its limbs are shorter, and its body much thinner. Its perfume is weak, and of short duration: but the perfume of the civet is very strong; and that of the zibet is still more violent and piercing. This odorous liquor is found in the fissure which these two animals have near the organs of generation. It is a thick humour, of the consistence of pomatum, and its perfume, though very strong, is agreeable, even when it issues from the body of the animal. This matter of the civet must not be confounded with musk, which is a sanguineous humour, derived from an animal totally different from the civet or zibet. The animal which produces the musk is a species of roebuck or goat without horns, which has nothing in common with the civets but its strong perfume.

Hence these two species of civets have never been properly distinguished. Both have sometimes been confounded with the stinking weasels, the genet, and the musk deer; they have also been mistaken for the hyæna. Belon, who has given a figure and description of the civet, maintains that it was the hyæna of the ancients. His error is the more excusable that it is not without some foundation. It is certain that most of the fables related concerning the hyæna have been derived from the civet. The philters, said to have been extracted from certain parts of the hyæna, and their power of exciting love, indicate sufficiently that the ancients knew the stimulating virtue of the civet's pomatum, which is still used for this purpose in the east. What they have related concerning the uncertainty of the sex in the hyæna applies still better to the civet; for in the male nothing appears externally but three apertures, so perfectly similar to those of the female that it is impossible otherwise to distinguish the sex than by dissection. The aperture in which the liquor, or rather thick odorous humour, is found, lies between the other two, and in the same direct line which extends from the os sacrum to the pubis.

The error of Gregoire de Bolivar with regard to the climates which gave birth to the civets, has been more generally diffused than that of Belon. After telling us that they are common in Africa and the East Indies, he asserts positively, that they are very numerous in every part of South America. This assertion, transmitted to us by Faber, has been copied by Aldrovandus, and adopted by all succeeding writers on the subject. It is certain, however, that the civets are peculiar to the warm climates of the Old Continent, and could never pass by the north into America, where in fact no civets ever existed till they were transported from the Philippine islands and the coast of Africa. But as the assertion of Bolivar is positive, and mine negative only, I must give my reasons for proving the falsity of the fact. 1. Faber's figure was left to him by Recchi, without any description. Upon this figure is inscribed *animal zibethicum Americanum*. It has no similarity either to the civet or zibet, but rather resembles the badger. 2. Faber gives a description and figures of the male and female civet, which resemble our zibet; but these civets are not the same animal with that represented in the first figure; and the second two are not figures of American animals, but of civets belonging to the Old Continent, of which Fabius Columna, fellow-member with Faber of the Lyncean academy, had obtained drawings at Naples, and sent him the figures and descriptions. 3. After quoting Gregoire de Bolivar concerning the climates where the civet is found, Faber concludes with admiring

Bolivar's great memory, and with telling us, that he heard all this relation from the mouth of its author. These three remarks are alone sufficient to throw a suspicion on this pretended *animal zibethicum Americanum*, as well as upon the assertions of Faber borrowed from Bolivar. But to render our detection of this error complete, we find, in a tract composed by Fernandes upon American animals, at the end of the volume which contains the Natural History of Mexico by Hernandes, Recchi, and Faber, a passage that flatly contradicts Bolivar, and where Fernandes assures us, that the civet is not an American animal, but that in his time some of them had been transported from the Philippine islands to New Spain. In fine, by uniting this positive testimony of Fernandes to that of all the travellers who say that the civets are very common in the Philippine islands, in the East Indies, and in Africa, none of whom mention their even having seen these animals in America, it will no longer admit of a doubt, that the civet is not a native of America, but an animal peculiar to the warm climates of the Old Continent, and was never found in the New till after it had been transported thither. If I had not guarded against mistakes of this kind, which are too frequent, I would have announced our civet as an American animal, because it was transmitted from St. Domingo; but having examined the memoir and letter of M. Pagés, which accompanied the animal, I found that it came originally from Guinea. These particular facts I consider as so many proofs of the general position, that there is a real distinction between all the animals peculiar to the southern regions of each continent.

[The civet above-mentioned was brought from Guinea. It fed upon fruits; but it likewise very willingly eat flesh. While it lived it diffused to a great distance an insupportable odour of musk; and after its death I was not able to endure the scent in a chamber. Immediately above the scrotum I found a fissure, which was a common passage to two pouches, one on each side of the testicles. These pouches were full of a gray, thick, viscid humour, mixed with long hairs of the same colour with those I found in the pouches. The sacs or pouches were about an inch and a half deep; and their diameter was much larger at the top than at the bottom.]

Hence the civet and the zibet belong to the Old Continent. They differ from each other only by the external marks formerly pointed out. For the structure of their internal organs, and of the reservoirs which contain their perfume, I must refer to the excellent descriptions of Messrs. Morand and Pyronnie. With regard to what remains of the history of these two animals, as it is difficult to refer particular facts to the one in preference to the other, I have comprehended the whole under one article.

The civets, though originally natives of the warm climates of Africa and Asia, can live in temperate and even in cold countries, provided they are defended from the injuries of the weather, and are fed with succulent nourishment. Numbers of them are kept in Holland for the purpose of selling their perfume. The civet made at Amsterdam is preferred by our merchants to that which comes from the Levant or India, because the latter is generally less pure. That brought from Guinea would be the best if the Negroes, as well as the Indians and Levanters, did not adulterate it with the juices of plants, or with labdanum, storax, and other balsamic and odoriferous drugs.

[There are a number of civets in Malabar. It is a small animal, nearly of the figure of a cat, only its muzzle is sharper, its claws less dangerous, and its cry different. The perfume it produces is secreted, like a kind of grease, in an aperture under the tail. It is extracted from time to time, and never abounds except the animal be well fed. It constitutes a great trade at Calicut; but unless a man collects it himself, it is almost always adulterated.]

To collect this perfume the animal is put into a narrow cage where he cannot turn himself. The cage is opened at one end; the animal is drawn a little out by the tail, and fixed in this position by putting a stick across the bars of the cage, which likewise enables the people to lay hold of the hind legs. They then introduce a small spoon into the sack that contains the perfume, with which they scrape all its internal sides, and put the matter into a vessel, which is covered up with great care. This operation is repeated two or three times a-week. The quantity of odorous humour depends much on the quality of the nourishment, and the appetite of the animal, which always produces more in proportion to the goodness of its food. Boiled flesh, eggs, rice, small animals, birds, young poultry, and especially fishes, are the best kinds of food, and they ought to be varied in such a manner as to preserve the health and excite the appetite. He requires very little water; and though he drinks seldom he discharges urine frequently; and in this operation the male is not to be distinguished from the female.

The perfume of these animals is so strong that it infects all parts of the body; the hair and skin are so thoroughly penetrated with this odour that they retain it long after death; and during life it is so violent as to be quite insupportable, especially if a person is shut up in the same apartment with the animal. When heated with rage the odour becomes more highly exalted; and if the animal be tormented till he sweats, the keeper collects the sweat, which has likewise a strong scent, and serves for adulterating, or at least augmenting the quantity of perfume.

The reservoir that contains the odorous liquor of the

civet lies below the anus, and above another orifice, which is so similar in both sexes, that without dissection all civets appear to be females. As this liquor becomes incommodious when the reservoirs are too full of it, the animal is provided with proper muscles for squeezing it out. Though it be collected in great quantities in these reservoirs, where it is likewise brought to the highest perfection, yet it seems to be diffused by absorption through the whole skin; for the hair of both our civets had a strong smell; that of the male particularly was so impregnated with perfume, that the hand after gently rubbing his hair retained an agreeable odour for a considerable time.—*Hist. de l'Acad. des Sciences.*]

The civets are naturally savage, and even somewhat ferocious; yet they are easily tamed, so as to be approached and handled without danger. They have strong sharp teeth; but their claws are weak and blunt. Though their bodies are thick, they are active and nimble. They leap like cats, but can likewise run like dogs. They live by hunting and surprising small animals and birds. Like the fox they enter the court-yards, and carry off poultry. Their eyes sparkle in the dark, and they probably see well during the night. When animal food fails them they eat roots and fruits. They drink little, never frequent moist places, and spontaneously live among burning sands and arid mountains. In their own climate they are very prolific; but though they can live and produce their perfume in temperate regions, they are incapable of multiplying. Their voice is stronger, and their tongue smoother than those of the cat; and their cry has a resemblance to that of an enraged dog.

In Europe the unctuous perfume extracted from these animals is called civet, and *zibet* or *algalia* in Arabia. It is more used in India and the Levant than in the more northern countries. It is hardly now employed as a medicine; but the perfumers and confectioners make use of it in the composition of their perfumes. The odour of the civet, though strong, is more agreeable than that of musk. But both of them lost their reputation upon the discovery of ambergris, or rather the mode of preparing it: and even the ambergris, which not long ago was esteemed for the excellence of its smell, has ceased to be admired by people of a refined and delicate taste.

SUPPLEMENT.

In the year 1772 M. de Ladebat sent a live civet to M. Bertin, secretary of state. This animal was given by the Dutch governor of Fort Mine on the coast of Africa, to the captain of one of M. de Ladebat's ships in the year 1770, and was landed at Bourdeaux in the month of November 1772. On its arrival it was very weak; but after some days resumed its strength, and at the end of five or six months its size was augmented about four inches. It was fed with raw and boiled flesh, fish, soup, and milk. It was kept warm during the winter; for it seemed to suffer much from cold, and became less ferocious when exposed to a cool air.

THE GENET

THE ears of the genet are a little pointed; the body is slender, and the tail very long. The colour of the body is a tawny red, spotted with black, and the ridge of the back is marked with a black line. The tail is annulated with black and tawny, and the feet are black. Sometimes the ground colour of the hair inclines to gray. It is about the size of a martin, but the fur is shorter.

The genet is a smaller animal than the civet. It has a long body, short legs, a sharp muzzle, a slender head, smooth soft hair of a shining greyish ash-colour, marked with black spots, which are round and detached on the sides, but unite so closely on the back that they seem to form continued black bars, stretching along the body. Upon the neck and spine there is a kind of mane or long hair, forming a black bar from the head to the tail, which last is as long as the body, and marked with seven or eight alternately black and white rings. The black spots on the neck are also in the form of bars; and under each eye there is a very conspicuous white spot. Under the tail, and in the same situation as in the civets, the genet has an aperture or sac, in which is secreted a kind of perfume; but it is weak, and soon loses its odour. The genet is longer than the martin, to which it has a great resemblance in figure, manners, and dispositions. But the genet seems to be more easily tamed. Belon tells us, that he saw genets in the houses of Constantinople, which were as tame as cats, and allowed to run about, without doing any kind of mischief; and that they are called Constantinople cats, Spanish cats, or genet cats. They have nothing, however, in common with cats but the art of watching and catching mice. It is perhaps because they are found only in Spain and the Levant that they have obtained the names of these countries; for the word genet is not derived from the ancient languages, and is probably a

new name, taken from some place frequented by the genet, which we know is very common in Spain, where a certain race of horses are called genets. Naturalists pretend that the genets inhabit only moist places, and the neighbourhood of brooks; and that they are never found in mountains or dry grounds. Their species is not numerous, or at least much diffused. There are none in France, or in any other province of Europe, except Spain and Turkey. Hence, for their subsistence and multiplication they require a warm climate; yet none of them appear to be found in the warm countries of Africa and India; for the fossane, which is called the Madagascar genet, is a different species, and shall afterwards be described.

The skin of this animal makes a light and handsome fur. Genet muffs were very fashionable some years ago, and gave a high price. But since we learned the art of counterfeiting them, by painting with black spots the skin of the gray rabbit, their price has fallen three-fourths, and the mode has changed.

SUPPLEMENT.

I remarked, under the article genet, that the species was not widely diffused, and that there were none of them in France nor in any other province of Europe, except Spain and Turkey. I had then not learned that genets were found in our southern provinces, and that they are very common in Poitou, where they are known by the name of genets, even to the peasants, who assure us that these animals inhabit only moist places and the banks of rivulets.

The Abbé Roubaud, author of the *Gazette d'Agriculture*, and several other useful works, was the first who announced to the public the existence of this animal as a native of France. In the month of April 1775 he sent me a genet which he had killed at Livray in Poitou, and which, except some variations in the colour of the hair, was the same with the Spanish genet. This animal is likewise found in the neighbouring provinces.

'For these thirty years that I have lived in the province of Rouergue,' says M. Delpeche, 'it has been a 'constant practice among our peasants to bring dead 'genets every winter to a certain merchant of this place, 'who told me that they were not numerous, but that 'they live in the neighbourhood of Villefranche, and 'burrow during the winter in holes like rabbits. If 'necessary I can send you some dead specimens of this 'creature.'

We have given a figure of the female genet, which differs so much from the female formerly represented as to merit a particular description. It was shown at the fair of St. Germain in the year 1772. It was fierce, and endeavoured to bite. It was kept in a narrow roundish cage, which rendered it difficult to be drawn. It was fed with flesh, and had the physiognomy and all the principal characters of the genet formerly represented. The head was long and slender; the muzzle was also long, and advanced beyond the under jaw. The eye was large, with a narrow pupil. The ears were round; and the hair of the head and body was spotted. The tail was long and bushy. This animal was somewhat thicker than the former. The latter indeed was young, for it grew considerably larger in three or four months: we could not learn from what country it had been brought; the keeper had purchased it, seven or eight months before, in London. It was in perpetual motion, never resting, except during the time it slept.

The genet now under consideration was twenty inches long, and seven inches and a half high. The upper part of the neck was more bushy than that of the former genet, whose hair was all of an equal length. The circular bars on the tail are less distinct, and indeed extend not farther than about one third part of the tail. The whiskers are black, and much longer, being two inches seven lines long, and lie upon the cheeks, instead of being erect, as in the cats and tigers. The nose is black, and the nostrils very much arched. Above the nose there is a black line, which extends to between the two eyes, and is accompanied by two white bands. Above the eyes there is a white spot, and a white band below them. The ears are black, but longer and narrower at the base than those of the first genet. The hair of the body is of a whitish gray colour, mixed with large black hairs, which being reflected seem to form a kind of black undulations. The upper part of the back is striped and spotted with black; the rest of the body is marked in the same manner, but the black is fainter. The belly is white, and the legs and thighs black. The paws are short; and there are five toes on each foot. The claws are white and crooked. The tail is sixteen inches long, and about two inches thick at the origin; the upper third part of the tail is of the colour of the body, and marked with black rings, which are very ill defined. The other two thirds of it are black.

THE CANADIAN MUSK RAT, AND THE MUSCOVY MUSK RAT.

THE musk beaver has a thick blunt nose, short ears almost hid in the fur, and large eyes. The toes on each foot are separated, the hind ones being fringed on the sides with long hair closely set together. The tail is compressed sidewise, very thin at the edges, and covered with small scales, intermixed with a few hairs. The head and body are of a reddish brown, and the breast and belly of an ash-colour tinged with red. The fur is very fine. The length, from the nose to the tail, is one foot, and that of the tail nine inches. In the form of its body it exactly resembles a beaver.

The long nosed beaver has a long slender nose, like that of a shrew mouse, no external ears, very small eyes, and a tail compressed sidewise. The head and back are dusky, and the belly is of a whitish ash-colour. The length, from nose to tail, is seven inches, and that of the tail is eight inches.

Though these two animals have received the same denomination of musk rats, and have some common characters, they ought not to be confounded. They should likewise be distinguished from the pilori or musk rat of the Antilles: they all form different species, and belong to different climates; the first being found in Canada, the second in Lapland and Muscovy, and the last in Martinico and other of the Antilles islands.

The Canadian musk rat differs from the Muscovian by having all its toes separate, conspicuous eyes, and a very short muzzle. But the musk rat of Muscovy has the toes of the hind feet webbed, very small eyes, and a long muzzle, like that of the shrew mouse. Both have long compressed tails, and differ from the musk rat of the Antilles in this and several other characters. The latter has a very short tail, which is cylindrical, like that of the common rat. But both of the former have very long tails. The head of the Canadian musk rat resembles that of the water rat, and the head of the Muscovy kind resembles that of the shrew mouse.

In the memoirs of the Academy of Sciences, ann. 1725, there is a very complete description of the Canadian musk rat. M. Sarrasin, king's physician at Quebec, and correspondent of the academy, has dissected a number of these animals, and made some singular remarks. By comparing his description with ours, we are perfectly persuaded that the musk rat of Canada is the same animal whose figure is here represented.

The Canadian musk rat is of the size of a small rabbit, and of the figure of a rat. Its head is short, and resembles that of the water rat. Its hair is soft and glossy; and beneath the first hair there is a thick down, nearly resembling that of the beaver. Like other rats its tail is long and covered with scales; but its form is different; for instead of being cylindrical, it is compressed laterally from the middle to the extremity, and roundish near the origin. The toes are not united by membranes, but garnished with long close hair, which assists the animal in swimming. Its ears are very short, and not naked as in the common rat, but covered, both internally and externally, with hair. The eyes are large, their aperture being about three lines. In the under jaw there are two cutting teeth, about an inch long, and two shorter ones in the upper. These four teeth are very strong, and serve the animal for gnawing and cutting wood.

The singularities observed in this animal by M. Sarrasin are, 1. The great muscular force in its skin, which enables the creature to contract its body into a small volume: 2. The suppleness of the false ribs, which admits this contraction, and is so considerable that the musk rat is enabled to pass through holes where much smaller animals cannot enter: 3. The manner in which the females discharge their urine; for the urethra terminates not, as in other quadrupeds, under the clitoris, but at a hairy eminence above the os pubis; and in this eminence there is an aperture that allows the urine to escape. This singular organization is peculiar to a few species of animals, as the rats and apes, the females of which have three apertures. It has been remarked that the beaver is the only quadruped whose urine and excrement are discharged by a common aperture. The female rats and apes are perhaps the only animals who discharge their urine by an aperture separated from the organs of generation. But this singularity is confined to the females, the structure of the males being the same with that of other quadrupeds. 4. M. Sarrasin farther remarks, that the testicles, which, as in other rats, are situated on each side of the anus, become in the rutting season very large in proportion to the size of the animal, their bulk being often equal to that of a nutmeg; but that after this season they diminish so greatly as not to exceed a line in diameter; and that they not only undergo a change of size, consistence, and colour, but even their situation is remarkably varied. In the same manner, after the season of love, the seminal vessels, the vasa deferentia, and all the organs of generation, are almost entirely obliterated: the testicles, which, during this period were external and very prominent, retire

within the body. They are fixed, like the other parts just mentioned, to the membrana adiposa. This membrane, by the redundant nourishment, gradually expands and increases till the arrival of the rutting season, when the organs of generation, which seem to be appendages of the membrane, unfold, swell, and acquire their complete dimensions. But when the redundant nourishment is exhausted by reiterated embraces, the membrane turns meagre, contracts, and gradually retires toward the reins, carrying along with it the vasa deferentia, the seminal vessels, and the testicles, which last become so light, empty, and shrivelled, as hardly to be distinguishable. In the same manner the seminal vessels, which at the commencement of the rutting season are an inch and a half long, are afterwards reduced to a line or two in diameter: 5. That the follicles which contain the perfume of this animal in the form of a milky humour, and which are situated near the organs of generation, undergo the same changes. In the rutting season they are large and turgid, and their perfume is so strong and highly exalted, that it is perceptible at a great distance. They afterwards contract, shrivel, and at last entirely disappear. This change in the follicles which contain the perfume is more rapid and complete than that which happens to the organs of generation. These follicles are common to both sexes, and in the rutting season contain a considerable quantity of milky humours secreted by vessels, which in the male terminate at the extremity of the penis, and toward the clitoris in the female. This secretion is performed, and the humour evacuated, nearly at the same place as the urine in other quadrupeds.

All these peculiarites remarked by M. Sarrasin were worthy the attention of so able an anatomist. In the history of the water rat, the mole, and short-tailed field mouse, we have mentioned similar changes in the organs of generation. Thus we find quadrupeds, though in their general structure they resemble the other animals of the same class whose organs of generation are annually obliterated and renewed, nearly in the same manner as the milts of fishes, and the seminal vessels of the calmar, whose changes, annihilation, and reproduction, have been formerly described. These shades, by which nature connects beings apparently the farthest removed from each other, these singular examples, should never be neglected; because they belong to the general system of organization, and unite the most distant points of animated bodies. But this is not the place for expatiating on the general conclusions which might be drawn from these singular facts, nor on the close connection they have with our theory of generation. They will be anticipated by the intelligent reader; and we shall soon have occasion to exhibit them to greater advantage, by adding them to other facts of a similar nature.

As the Canadian musk rat belongs to the same country with the beaver, dwells on the water, and has nearly the same figure, colour, and fur, they have often been compared to each other. It is even asserted, that a full grown musk rat at first sight may be mistaken for a beaver of a month old. They differ greatly however in the form of the tail, which in the beaver is oval and flat horizontally; but in the musk rat it is very long and flat, or compressed vertically. Besides, these animals have a great resemblance in their dispositions and instincts. The musk rats, like the beavers, live in society during the winter. They make little huts, about two feet and a half in diameter, and sometimes larger, where several families associate together. It is not the object of this operation, like that of the marmots, to sleep during five or six months, but solely to shelter them from the rigour of the air. These houses or huts are round, and covered with a dome about a foot thick. Their materials are herbs and rushes interlaced, and cemented with earth, which they plash with their feet. They are impenetrable to rain, and furnished with steps in the inside to prevent their being injured by inundations from the land. These huts, which serve the animals for a retreat, are covered during winter with several feet of snow and ice, without incommoding them. They lay not up provisions, like the beaver, but dig a kind of pits or passages under and round their habitations, to give them an opportunity of procuring water and roots. Though thus associated they pass the winter in melancholy; for it is not the season of their amours. During all this period they are deprived of light; and when the gentle breezes of the spring begin to dissolve the snow, and to discover the tops of their habitations, the hunters open the dome, suddenly dazzle them with the light, and kill or seize all those who have not had time to retire to their subterraneous galleries, into which they are still followed; for their skin is valuable, and their flesh makes tolerable good eating. Those who escape the vigilance of the hunter quit their habitations at this time. They wander about during summer, but always in pairs, because it is the season of their amours. They feed upon herbs, and voraciously devour the fresh productions of the earth. By this redundance of excellent nourishment the membrana adiposa expands, increases, and is filled with fat; the follicles are also renewed and filled; the organs of generation unfold and swell; and then the animals acquire an odour of musk, so strong as to be hardly supportable. This odour is perceived at a distance; and though agreeable to Europeans, is so disgustful to the savages, that they have denominated a river inhabited by a vast number of these rats the Stinking River.

[The musk rat of North America is somewhat thicker and longer than our water rat. Water is its element; but it sometimes goes upon land. It has a flat tail, from eight to ten inches long, an inch broad, and covered with small black scales. Its skin is reddish, and the fur very

fine. Near the testicles there is a matter which has a most agreeable smell of musk, and does not incommode those to whom musk is offensive. In winter, when they are killed for the sake of their fur, they have no odour; but it begins to be perceptible in spring, and continues strong till autumn. The flesh, which has no flavour of musk, makes excellent food.]

The females bring forth annually five or six young. Their time of gestation is not long; because they come in season in the beginning of summer, and the young are pretty large in the month of October, when they retire with their parents into the huts, which are built every year; for it has been remarked that they never return to their old habitations. Their cry is a kind of groaning, which the hunter counterfeits in order to make them approach him. Their fore teeth are so strong, and so proper for cutting, that when shut up in a box of hard wood they soon make a hole sufficient for their escape, which is a faculty they have in common with the beaver. They swim neither so swift nor so long as the beaver; but often go upon the ground. They do not run well, and they walk still worse, rocking from side to side like a goose. Their skin preserves the smell of musk, which renders their fur not so generally agreeable; but the down, or under hair, is used in the manufacturing of hats.

These animals are not remarkably wild, and when taken young are easily tamed. They are then very pretty; and their tail, which is long and flat, and makes their figure disagreeable, is at this period of life very short. They sport with as much innocence and gentleness as young cats. They never bite, and might be easily reared, if their odour were not disagreeable.

[The musk rats of Canada, called *ondathra* by the Hurons, eat herbs and the pith of rushes about the lakes and rivers. When young, it is pleasant to see them eat and perform their little gambols. I had a very pretty one, which I fed with the pith of rushes, and an herb similar to the dandelion. They are not apt to bite; for I handled mine at pleasure, without the smallest danger of injury.—*Voyage de Sagard Theodat.*]

The Canadian and Muscovy musk rats are the only northern animals which yield a perfume; for the odour of the *castoreum* is extremely offensive; and it is only in warm climates that the animals which furnish the true musk, the civet, and other perfumes, are to be found.

The musk rat of Muscovy would perhaps exhibit to us peculiarities similar to those of the Canadian; but it seems not to have been dissected or examined alive by any naturalist. We can only mention its external form, that preserved in the king's cabinet having been sent from Lapland in a dry state. We must therefore regret that so little is known of this animal.

THE MEXICAN HOG.

THE Mexican hog has four cutting teeth above, six below, and two tusks in each jaw; those in the upper jaw pointing down, and little apparent when the mouth is shut; the others hid. The length from the nose to the anus is about three feet. The head is not so taper as in common swine. The ears are short and erect. The body is covered with bristles, stronger than those of the European kind, and more like those of a hedgehog; they are dusky, surrounded with rings of white; those on the top of the neck and back are five inches long; they grow shorter on the sides. The belly is almost naked. From the shoulders to the breast there is a white band. It has no tail. On the lower part of the back there is a gland open at the top, which discharges a fetid ichorous liquor, which has been mistakingly called a navel.

Of all the animals in the New World the Mexican hog is the most numerous and most remarkable species. At first sight he resembles our wild boar, or rather the hog of Siam, which, as formerly remarked, is only a variety of the wild boar. In the same manner the Mexican hog has been called the boar or hog of America. He constitutes, however, a different species; for from repeated trials it has been found that he does not intermix either with our wild or domestic kinds. He likewise differs from the hog in several essential characters, both external and internal. He is not so corpulent, and his legs are shorter. The form of his stomach and intestines is also different. He has no tail. His bristles are much coarser than those of the wild boar. Lastly, on his back, near the crupper, there is an orifice about three lines broad, and more than an inch deep, from which an ichorous humour, of a very disagreeable smell, flows very copiously. No other animal has an aperture in this region of the body. The civets, the badger, and the genet, have the reservoir of their perfume under the organs of generation; and the Canadian musk rat and the musk animal have it under the belly. The liquor which issues from the dorsal aperture of the Mexican hog is secreted by a number of large glands, which are

well described by M. Daubenton and by Dr. Tyson. It is unnecessary to give in detail the observations of these acute anatomists. It shall only be remarked, that Dr. Tyson is wrong in asserting that this animal has three stomachs, or, as Mr. Ray expresses it, a gizzard and two stomachs. M. Daubenton has clearly demonstrated that it has but one stomach divided by two strangulations, which give it the appearance of three; that only one of these three bags has a pylorus, or aperture for allowing the descent of the aliment into the other intestines; and consequently that the other two should be regarded as appendages or rather portions of the same stomach.

The Mexican hog might be rendered domestic as well as the common kind. He is nearly of the same dispositions, feeds upon the same nourishment, and his flesh, though drier and less loaded with fat, is by no means disagreeable. It is likewise improved by castration; but when his flesh is intended to be eaten, not only the organs of generation, as is practised on the wild boar, but the whole dorsal glands of both male and female should be cut off instantly after death; for the retention of them for a single half hour gives the meat an odour so strong as to render it uneatable.

These animals are very numerous in all the warm climates of South America. They go in herds, which sometimes amount to two or three hundred. For defending themselves, and repelling those who want to deprive them of their young, they are endowed with the same instincts as the common hog. They mutually assist each other; they surround their enemies, and often wound the dogs and the hunters. In their native country they prefer the mountains to the plains. They search not for marshes and mires, like our wild boar, but remain in the forests, where they live upon fruits, seeds, and roots. They likewise eat serpents, toads, and lizards, whose skins they previously tear off with their feet. They produce a great number at a time, and perhaps more than once a-year. The young soon follow their mother, and never separate from her till they are full grown. When taken young they are easily tamed; they lose their natural ferocity, but retain their stupidity; for they know no person, and have no attachment to those who take care of them. They do no mischief, and may be allowed to go and come at pleasure without any inconvenience. They never stray, but return home spontaneously; and they never quarrel, but when a number of them are presented with victuals in the same trough. When angry their grunting is stronger and harder than that of the common hog; but they seldom cry. Like the wild boar, when suddenly alarmed, they make a sharp blowing kind of noise. Their breath is very strong; and, when irritated, their hair rises, which is so coarse that it rather resembles the prickles of a hedge-hog than the bristles of the wild boar.

The species of the Mexican hog is preserved without any change; for they never intermix with those hogs which were transported from Europe, and have become wild in America. These animals often meet in the woods, and even go in company, without producing any new variety. The same observation applies to the Guinea hog, which has multiplied greatly in America after being brought thither from Africa. The European hog, the Guinea hog, and the Mexican hog, are three species, which, though they seem to approach very near each other, are perfectly distinct, since they all subsist in the same climate without change or intermixture. Our wild boar is the strongest and most formidable of the three. The Mexican hog is equally ferocious; but he is weaker, more unwieldy, and worse armed, his tusks being much shorter than those of the wild boar. The former is impatient of cold, and cannot subsist, even in our temperate climates, without being sheltered, and the wild boar cannot subsist in very cold countries. Hence neither of these animals could pass from one continent to the other by the lands lying toward the north pole; and therefore the Mexican hog cannot be regarded as the European hog altered or degenerated by the influence of the American climates, but as an animal peculiar to the southern regions of the New World.

Ray and other authors maintain, that the liquor secreted by the dorsal glands of the Mexican hog is a kind of musk, an agreeable perfume, even when it issues from the body of the animal; that it is perceived at a great distance; and that it perfumes the places where he inhabits, or through which he passes. But on the contrary, I have a thousand times experienced, that the odour of this liquor, when it escapes from the animal, is so nauseous, that we could neither smell nor collect it without extreme disgust. It seems only to become less fetid by drying in the air; but it never assumes the agreeable odour of musk or of civet; and naturalists would have made a nearer approach to truth if they had compared it to that of *castoreum*.

SUPPLEMENT.

M. de la Borde remarks, that in Cayenne there are two distinct species of the pecari or Mexican hog, which never intermix. The largest kind, says he, has white hair on its chops; and on each side of the jaw there is a round white spot, of the size of a small crown-piece. The rest of the body is black; and the animal weighs about one hundred pounds. The smaller species has reddish hair, and weighs not above sixty pounds.

It is the large species which is here represented. And with regard to the smaller kind, the difference of colour and size mentioned by M. de la Borde must be only a variety produced by age or some other accidental circumstance.

M. de la Borde however says, that the large kind runs not like the small after dogs and men. He adds, that both species inhabit the large woods, and that they go in flocks of two or three hundred. They feed on the mountains during the rainy season; and when it is past they frequent the low and marshy grounds. They feed upon fruits, seeds, and roots, and likewise dig in the mires in quest of worms and other insects. They are hunted without dogs, by following the track of their feet. They are easily shot; for instead of flying they assemble together, and often give the hunters an opportunity of charging and discharging several times. They pursue the dogs, and sometimes men. He relates, that being one day employed along with several others in hunting these animals, accompanied by a single dog, which, as soon as they appeared, took refuge between his master's legs. For the greater safety he with other hunters stood on a rock. They were nevertheless surrounded by the flock of hogs. A constant fire was kept up; but the creatures did not retire till a great number of them were slain. These animals, however, he remarks, fly after they have been several times hunted. The young, when taken in the chase, are easily tamed; but they will not associate or mix with the domestic species. In their natural state of liberty they frequent the marshes, and often swim across large rivers. They make great havock in the plantations. Their flesh, says he, has an excellent taste, but is not so tender as that of the domestic hog; it resembles the flesh of the hare, and has neither lard nor grease. The females bring forth only two at a litter; but they produce in all seasons. When killed the dorsal gland should be instantly cut out, otherwise it will give a bad flavour to the meat.

M. de la Borde mentions another species of hog, which he calls *patira*, and is also found in Guiana. I shall transcribe what he remarks of this animal, solely with a view that he or some other observer may furnish us with more precise information, and a more complete description of it.

'The patira is of the size of the smaller species of 'Mexican hog; and differs from it only by having a 'white line along the spine from the neck to the tail.

'These animals live in the large forests, from which 'they never depart. They associate not in large flocks, 'but in families. They are however very common, and 'never leave their native country. They are hunted with 'or without dogs. When pursued by dogs they stand 'firm and defend themselves with courage. They take 'refuge in hollow trees, or in holes of the earth dug 'by the armadillos. These holes they enter backwards, 'and remain as long as they can: but when highly irri-'tated they instantly issue out in a body. In order to 'seize them as they come out, the hole is inclosed with 'branches of trees; one of the hunters, armed with a 'pitchfork, stands above the hole to fix them by the 'neck, while another forces them out and kills them 'with a sabre.

'When there is but one in a hole, and the hunter has 'not leisure to seize it, he shuts up the entrance, and is 'sure of his game next day. The flesh of the patira 'is superior to that of other hogs. When taken young 'they are easily tamed; but they have a mortal anti-'pathy to dogs, whom they perpetually attack. The 'females bring forth only two at a time; and they are 'fit for procreating in every season of the year. They 'keep always in the marshes, unless when totally covered 'with water.

'The hair of the patira is not so hard as that of the 'wild boar or domestic hog, but is soft and flexible like 'that of the pecari. The patira when tamed follows his 'master, and allows himself to be handled by those with 'whom he is acquainted; but strangers he threatens 'with his head and teeth.'

THE TERNAT BAT, THE LESSER TERNAT BAT, AND THE VAMPIRE OR SPECTRE.

THE bats or winged quadrupeds are distinguished from all other animals by having long toes on the fore feet, connected by thin broad membranes extending to the hind legs.

The great or Ternat bat has large canine teeth, four cutting teeth above, and an equal number below, a sharp black nose, and large naked ears. The tongue is pointed, and terminated by sharp aculeated papillæ. The exterior toe is detached from the membrane, and the claw is strong and hooked. There are five toes on the hind feet; the talons are very crooked, strong, and compressed sidewise. It has no tail; the membrane is divided behind quite to the rump. The head is of a dark ferruginous colour; on the neck, shoulders and underside, the red is much lighter and brighter. On the back the hair is shorter, dusky, and smooth. The membranes

of the wings are dusky. They vary in colour; some are entirely of a reddish brown, others dusky. This now described was one foot long, and the extent of the wings from tip to tip was four feet. But they are found vastly larger.

M. Brisson has separated with propriety the Ternat bat from the common bat. Linnæus is wrong when he says, that all bats have four cutting teeth in each jaw. This character is true in the Ternat bats; but the common bats have four cutting teeth in the upper jaw, and six in the under; and, consequently, according to Linnæus's method of classing, by the number and arrangement of the teeth, these animals cannot belong to the same genus.

The vampire or spectre has a long nose, large teeth, and long, broad, upright ears. At the end of the nose there is a long conic erect membrane, bending at the end, and flexible. The hair on the body is cinereous, and pretty long. The wings are full of ramified fibres. The membrane extends from hind leg to hind leg. It has no tail; but from the rump extend three tendons terminating at the edge of the membrane. By Seba's figure the extent of the wings is two feet two inches, and from the end of the nose to the rump seven inches and a half.

Though the two Ternat bats appear to be distinct species, we have placed them together because of their great resemblance; for they differ only in magnitude and colour. The larger, whose hair is of a reddish brown colour, is nine inches long from the end of the muzzle to the extremity of the body; and the wings when extended are three feet from tip to tip; and the lesser, whose hair is of a cinereous brown colour, exceeds not five and a half inches in length, and the wings extend not above two feet; and it has on the neck a half-collar of a lively red, mixed with orange, of which there is no vestige in the larger kind. Both belong nearly to the same warm climates of the Old World, being found in Madagascar, Mauritius, Ternat, the Philippines, and other islands of the Indian Arcipelago, where they seem to be more common than on the adjacent continents.

In the warm countries of the New World there is another flying quadruped, the American name of which we have not learned. We shall call it *vampire*, because it sucks the blood of men and other animals when asleep without occasioning pain sufficient to waken them. This American animal is of a different species from the two Ternat bats, both of which are peculiar to Africa and the south of Asia. The vampire is smaller than either of the Ternat bats. The first, when it flies, appears to be of the size of a pigeon; the lesser Ternat bat is of the size of a crow, and the largest is as big as a large hen. Both Ternat bats have well formed heads, short ears, and rounded muzzles, nearly resembling that of a dog. The muzzle of the vampire, on the contrary, is longer; its aspect is equally hideous as that of the most ugly bats; its head is ill shaped; and its ears are large, open, and very erect. It has a deformed nose, the nostrils being of the shape of a funnel, with a membrane above them, which is elevated like a horn or painted crest, and adds greatly to the deformity of its countenance. Hence it is apparent that this species is totally different from the Ternat bats. The vampire is not more remarkable for its deformity than its mischief. Of this we have the recent and authentic testimony of M. de la Condamine: 'The bats, 'says he, 'which suck 'the blood of horses, mules, and even of men, if they 'do not sleep under the shelter of a house or tent, are 'a common scourge to most of the warm countries of 'America. Some of them are of a monstrous size. At 'Borja and several other places they have entirely de-'stroyed the cattle which had been introduced there by 'the missionaries, and begun to multiply.' These facts are confirmed by several other historians and travellers. P. Martyr, who wrote soon after the conquest of South America says, that in the isthmus of Darien there are bats which suck the blood of men and cattle when asleep to such a degree as to weaken and even kill them. This fact is likewise affirmed by Jumilla, as well as Don George Juan, and Don Antoine de Ulloa. Though it appears from these authorities that the blood sucking bats are very common in all South America, we have never hitherto been able to procure a single individual. But Seba has given a figure and description of this animal, whose nose is so extraordinary that it is surprising such a conspicuous deformity should not have been taken notice of by travellers. The strange animal described by Seba may not be the vampire or blood-sucker. Seba's figure may be erroneous; and the deformed nose may be only an accidental monstrosity, though there are examples of similar and permanent deformities in other species of bats. Time alone can remove these uncertainties.

[In South America the bats are incredibly troublesome. There are two kinds, one of the size of those we see in Spain; the other so large that the wings extend three quarters of a yard. Both are dexterous blood-suckers, and fly about during the night in quest of men and cattle. If those who are obliged to sleep on the ground do not cover themselves from head to foot, which is very inconvenient in these warm regions they are certain of being pierced by the bats. With regard to those who sleep in houses with their front only uncovered, they are infallibly bit; and if these animals strike a vein the unfortunate person often passes insensibly from sleep to death by the loss of blood, so subtile is the wound inflicted: besides, by fanning the air with their wings they refresh the sleeper whom they mean to deprive of life.—*Hist. Nat. de l'Orenoque.*]

Both the Ternat bats are in the royal cabinet, and were brought from the isle of Bourbon. They are peculiar to the Old Continent, and are no where so numerous in Africa and Asia as the vampire is in America. These animals are larger, stronger, and perhaps more mischievous than the vampire. But their destruction is executed by open force, both during the day and the night. They kill poultry and small birds: they attack men, and often wound them in the face. But no traveller mentions their sucking the blood of men or cattle when asleep.

The ancients had an imperfect knowledge of these winged quadrupeds, which are a kind of monsters; and it is probable, that from such whimsical models of nature they had conceived the idea of harpies. The wings, the teeth, the claws, the cruelty, the voracity, the filthiness, and every other deformity and destructive quality ascribed to the harpies, correspond very well with our Ternat bats. Herodotus appears to point them out when he says, that there were large bats which were extremely troublesome to the people who gather cassia around the marshes of Asia; and that they were obliged to cover their bodies and faces with leather to defend themselves against the dangerous bites of these animals. Strabo speaks of large bats in Mesopotamia, whose flesh made good eating. Among the moderns, Albertus, Isidorus, and Scaliger, mention these large bats in a vague manner. Linscot, Nicolas Matthias, and Francis Pyrard have made more particular mention of them; and Oliger Jacobeus has given a short description and a figure of them. Lastly, descriptions and good figures of these animals, which correspond with our specimens, are to be found in Seba and Edwards.

[Nicolas Matthias, in a work printed at Visurbourg, in Sweden, says, that these large bats fly in flocks during the night; that they drink the juice of the palm-trees in such quantities as render them intoxicated, and make them fall, as if they were dead, at the roots of trees; that he seized one in this condition, and having nailed it to a wall, it gnawed and rounded the nails with its teeth, as if they had been filed. He adds, that its muzzle resembles that of a fox.

In the island of St. Lawrence, and in the Maldiva islands there are bats as large as crows.—*Voyage de Pyrard.*

In Malabar the bats fly at noon-day; they are as large as cats, and people eat them without reluctance.—*Biblioth. raisonn.*

There are two kinds of these bats in the *Museum Regium Haffniæ.* He says, that each of them were of the size of a large crow; that they were a foot long; and that the length of the penis was two inches. He adds, after Linscot, that they were eaten by the Indians, who thought them as delicate as partridges.]

The Ternat bats are carnivorous animals, and so voracious that they eat every thing; for when flesh or fish fail them they feed upon vegetables and fruits of all kinds. They drink the juice of the palm-tree; and it is easy to intoxicate and seize them by placing near their retreats vessels filled with palm-water or some other fermented liquor. They attach and suspend themselves to the trees by their claws. They generally fly in flocks, and more frequently in the night than in the day. They avoid places frequented by men, and dwell in the deserts, particularly in uninhabited islands. They copulate with ardour. The sex in the male is very conspicuous. The penis is not concealed in a sheath like that of the quadrupeds, but hangs out of the body like that of the monkey. The sex of the females is also very apparent. They have only two paps placed on the breast, and they produce few at a litter, but oftener than once a-year. The flesh of these animals when young is not bad to eat; the Indians compare the taste of it to that of a partridge or rabbit.

[In the Manilla islands we find an infinity of large bats hanging attached to each other upon the trees. They take flight in the evening, and go in quest of food to the distant woods. They sometimes fly in such numbers, and so close, that they darken the air with their wings, which are often six palms in extent. They know how to distinguish in the thickest woods the trees which bear ripe fruit. These they devour during the night, making a noise that may be heard at the distance of two miles, and return at day-break to their retreats. The Indians, who see these animals eating their best fruits, make war against them, not only to gratify revenge, but to feed upon their flesh, which they say tastes like that of a rabbit.—*Histoire Generale des Voyages.*]

All travellers through America agree, that the large bats of the New Continent have the faculty of sucking the blood of sleeping men and cattle without wakening them. The travellers into Asia or Africa who mention the Ternat bat, take no notice of this singular fact. Their silence however amounts not to a complete proof, especially as these creatures have so many other resemblances to the American vampires. We therefore thought it worthy of examination whether the Ternat bats (for we have not been able to procure the tongue of a vampire) could possibly suck blood without occasioning a pain sufficient to awaken a sleeping person. If they cut the flesh with their teeth, which are as large as those of other quadrupeds of the same size, a man in the most profound sleep, and particularly cattle, whose sleep is less profound, would be instantly roused by the pain. The same thing would happen if the wound was made by their claws. Hence it must be with their tongue alone that they are enabled to make such small apertures in the skin as to permit the blood to be extracted from the veins without occasioning a degree of pain. Upon examination M. Daubenton discovered that

the tongue of the Ternat bats was pointed, and armed with very hard, minute, sharp papillæ, which are bended backwards: these may be insinuated into the pores of the skin, and penetrate so far as to make a stream of blood flow by the constant suction of the tongue. But it is fruitless to reason upon a fact all the circumstances of which are not understood, and some of them perhaps exaggerated or unskilfully related.

SUPPLEMENT.

I find from a note communicated by M. Commerson, that he had seen in the isle of Bourbon millions of these large or Ternat bats, which in the evenings fly in flocks like crows, and perch upon trees, particularly the *vaccoun*, to eat the fruit. He adds, that when taken young they make good food, the taste of the flesh resembling that of the hare, and being equally black.

The late M. de la Nux, since the publication of my work, sent me from the same island, some excellent remarks upon what I had written concerning these animals. His letter, of which the following are extracts, is dated October 24, 1772.

'In your letter of the 8th March 1770, you declare 'that you are equally happy to be informed of truth, or 'to have your own errors corrected, and invite me to 'communicate my thoughts and remarks with the 'utmost freedom. I accept of the invitation, and am 'only afraid lest I should tire you by prolixity. With 'regard to the great or Ternat bats, to combat errors 'which have been long received, requires a variety of 'evidence. These animals, it would appear, have only 'been examined with the eye of fear: they have been 'regarded as ugly and monstrous; and therefore without 'farther examination than a bare inspection of their 'figure they have received a character, manners, and 'habits, which do not belong to them; as if mischiev-'ousness, ferocity, and dirtiness, were inseparable from 'ugliness of aspect.'

M. de la Nux remarks, that in my description both the size and number of the great Ternat bats are exaggerated; that there is nothing frightful in their cry; that it resembles the hoarse noise made by a man when he opens his mouth, contracts the wind-pipe, and makes several forcible expirations and respirations; and that when these animals are at rest on a tree, they make a gentle kind of murmuring, which is not disagreeable.

'Pliny with reason,' continues our author, 'treats 'the narrative of Herodotus as fabulous. The Ternat 'bats, at least in the islands, instead of attacking men, 'uniformly avoid them. They bite cruelly, but only 'when defending themselves from blows, or when they 'are seized; so that whoever is wounded by them must 'ascribe his misfortune to his own want of address, and 'not to the ferocity of an animal that has no such 'quality.

'Your size of the great Ternat bat approaches nearer 'to the truth. "*In Malabar the bats fly at noon-day.*" 'This is true of the larger, but not of the lesser Ternat 'bats. The former fly not in troops during the day, but 'singly, when they mount very high, which greatly 'diminishes their apparent magnitude. They fly long 'without stopping, and I believe that they can pass 'from the isle of Bourbon to the isle of France, a dis-'tance of at least thirty leagues, in a very short time. 'They never hover like birds of prey. But in the great 'elevation of perhaps two hundred fathoms above the 'surface of the earth, the motion of their wings, which 'is rapid when near the ground, appears to be very 'slow.

'Strictly speaking, the great Ternat bats live not in 'society. When in quest of food they unite into flocks 'or companies more or less numerous. These companies 'associate by accident upon the trees whose flowers or 'fruits are agreeable to their palates. They may be 'observed arriving successively, and laying hold of the 'trees by the claws of their hind feet, where they rest 'for a long time, if not disturbed. There are always some, 'however, which detach themselves from time to time, 'and join the company. But when a bird of prey passes 'above the tree, when they hear the noise of thunder, 'or of a musket, or when they spy any person in their 'neighbourhood, they all take wing at once. It is on 'such occasions that they are seen during the day flying 'in companies, which, though numerous, never obscure 'the air, because they cannot fly close enough to pro-'duce this effect: the expression is at least hyperbolical. 'But to say, that "*an infinity of large bats may be seen 'attached to each other upon the trees,*" is not only false 'but absurd. They are too peevish to hold each other 'in this manner by the hand; and if we examine 'their figure the impossibility of such a concatenation 'will be apparent. They rest on the branches above, 'below, or at each other's sides; but always remain 'separate.

'With regard to the lesser Ternat bats, they never fly 'in the day: they live in society, to the number some-'times of more than four hundred, in the hollow trunks 'of large corrupted trees, from which they depart not 'till the dusk of the evening, and return before day-'break. It is firmly believed in this island, that what-'ever numbers these societies consist of, there is never 'more than one male found among them: but I cannot 'attest this fact. I shall only remark, that these seden-'tary animals acquire a great degree of fatness, and that 'when this colony was first established, many people, 'whose taste and stomach were not too nice, collected 'vast quantities of bat grease for food. I have seen the 'time when a *tree of bats*, as it is termed, was no incon-'siderable treasure. It is easy to shut up the entrance 'of their retreats, to take them out alive one by one,

'or to suffocate them with smoke, and in either way 'to ascertain the number of males and females of which 'the society is composed. I know nothing more of this 'species. I return to the notes. Another hyperbole is, '"*They know how to distinguish, in the thickest woods, the 'trees which bear ripe fruit. These they devour during 'the night, making a noise that may be heard at the dis-'tance of two miles.*" In reading this passage, we are led 'to ascribe the noise to the act of mastication. The 'noise that is heard at a great distance, both in the night 'and the day, is that which is natural to the animals 'when in a passion, and when disputing about their 'food; for it must not be imagined that the large 'Ternat bats eat during the night only. They have a 'fine eye, as well as an acute scent. They see very well 'in the day; and it is not surprising that they should 'distinguish in the woods ripe fruit and grain as well 'as flowers. Besides, the bananas of every kind, of 'which they are very fond, the peaches and other fruits 'cultivated by the Indians, are not in the thickest parts 'of the woods. "*The flesh of these animals is not bad.*" 'True, if the reluctance excited by their figure could be 'overcome. When about five months old they are fat, 'and as good of their kind as the Guinea hen, or young 'wild boar; but when old they are hard, though pretty 'fat during the fruit season, which continues all the 'summer and a part of autumn. The males, especially 'when aged, acquire a strong disagreeable flavour. Nei-'ther is it correct to say, in general, that these animals '*are eaten by the Indians.* It is well known that the 'Indian neither eats nor kills any animal. Perhaps they 'are eaten by the Moors and Malayans. It is certain 'that many Europeans eat them. Hence it is true that 'bats are eaten in India, though not by the Indians. In 'this island both species are eaten.

'After this examination I proceed to the history of 'these animals, which likewise requires to be rectified. 'My proofs shall be drawn solely from my own obser-'vation, and from what has been alledged by those 'writers whom our historian of nature has followed.

'Both the great and lesser Ternat bats are natives of 'of the Isles of France, of Bourbon, and of Madagascar. 'I have resided in the isle of Bourbon upwards of fifty 'years. When I arrived in the month of September '1722 these animals were very common in districts 'already settled, where they are now become rare. The 'reasons are obvious: 1. The forests were then at no 'great distance from the settlements; and they cannot 'subsist but in forests. 2. The great Ternat bats are 'viviparous, and bring forth one young only each year. '3. For the sake of their flesh and their grease they are 'hunted during the whole summer, autumn, and part of 'winter, by the whites with muskets, and by the ne-'groes with nets. Besides these causes of diminution 'in the species, they abandon the neighbourhood of our 'settlements, and retire into the interior parts of the 'island, where they are exposed to constant destruction 'by the chesnut-coloured negroes.

'The season of their amours here is in the month of 'May, which is about the middle of our autumn, and 'the females bring forth a month after the vernal 'equinox. Hence the time of their gestation is from 'four and a half to five months. Of the precise time 'the young take in acquiring their full growth I have 'no knowledge: but I know that they appear to be 'perfect at the winter solstice, which is nearly eight 'months from their birth. Besides, no small bats are 'seen except in April and May, when the old are easily 'distinguished from the young by the more vivid colour 'of the latter. The old ones become gray, though I 'know not at what period; and it is then that their 'flesh is hard, and has so strong and disagreeable a 'flavour, that the fat alone, with which they are well 'provided from the end of spring to the beginning of 'winter, is eaten by the negroes.

'It is certain that these animals feed upon no kinds 'of flesh, but solely on bananas, peaches, and other 'fruits, which our forests produce abundantly in different 'seasons. They are likewise very fond of the juices of 'certain umbellated flowers, particularly those of our 'stinking tree, the nectarium of which is very short. 'These flowers abound in January and February, which 'is the middle of our summer, and allure into the lower 'parts of the island vast numbers of bats; and it is 'probably for the purpose of sucking the nectaria of 'umbellated flowers of different species that their tongue 'is furnished with so many sharp papillæ. The skin of 'the mango fruit is resinous, and is never touched by 'the bats. When confined in a cage they have been 'made to eat bread, sugar-canes, &c. I know not, 'however, whether they were made to eat flesh either 'raw or roasted. But supposing they had, it is not in 'a state of slavery that I am considering them; for 'bondage changes the manners, characters, and habits 'of all animals. Man has nothing to apprehend from 'these bats, either personally or for his poultry. It is 'impossible for them to seize even the smallest bird. 'They cannot, like a falcon, stoop down upon their 'prey. If they approach too near the ground they fall 'down, and are incapable of resuming their flight till 'they climb upon any elevated object they first meet 'with, supposing it should be the body of a man. [I saw a young Ternat bat fly into my house in the dusk of the evening, and fall down at the feet of a negress about eight years of age. It instantly began to climb up the child's body, who was luckily very near me. I quickly relieved her, lest the claws of its wings should have scratched her shoulders or face.] 'When 'on the ground they trail their bodies slowly along, and 'make their stay in that situation as short as possible.

'As they are by no means adapted for running, how is 'it practicable for them to seize birds on the branches of 'trees? The slow and awkward manner in which they 'move towards the end of a branch, in order to catch 'the wind in their wings, shows that every attempt of 'this nature would be abortive. When about to fly, 'these animals cannot, like birds, dart at once into the 'air. To disengage their claws from the place to which 'they are attached, they are obliged to beat the air 'several times with their wings; and however full their 'wings may be when they quit their station, their weight 'is apt to make them sink. In order to raise themselves 'they traverse the concavity of a curve line. But the 'place from which they depart is not always commo- 'dious for the free play of their wings. They may be 'restrained by the vicinity of branches; and when thus 'situated they proceed to the part of the branch from 'which they can take wing without any risk. It fre- 'quently happens, that when a numerous flock rest 'upon trees of twenty or thirty feet high, and are sur- 'prised by a peal of thunder, or the firing of a gun, 'several of them fall to the ground before they receive 'a sufficient quantity of air to support them. In this 'case they instantly climb the first tree they meet with, 'in order to resume their flight as soon as possible. 'Let us suppose that a traveller, hunting animals of 'which he has no knowledge, whose figure and aspect 'strike him with terror, is suddenly surrounded with a 'number of large bats; that he is entangled by one or 'two of them climbing up his body; that by roughly 'endeavouring to disengage himself he irritates the 'animals, and is scratched or even bit by them; would 'not a scene of this kind give rise to the notion that 'these bats were ferocious, rushing upon men in order 'to wound or devour them, while the whole affair is 'only a fortuitous rencounter of animals of different 'species, who are equally afraid of each other? I say 'more: the forest is absolutely necessary to the exist- 'ence of these bats, to which they are led by the in- 'stinct of self-preservation, and not by any savage or 'ferocious disposition. When to all these facts I add, 'that neither the great nor lesser Ternat bats ever fix 'upon carrion, and that naturally they do not eat upon 'the ground, but require to be in a hanging posture 'when they feed, I think I have said enough to eradi- 'cate the prejudice which represents them as carni- 'vorous, voracious, destructive, and cruel animals. 'When I farther add, that their flight is as heavy and 'noisy, especially when near the ground, as that of the 'vampire ought to be light and silent, I shall have, by 'this last character, removed the one species to a consi- 'derable distance from the other.

'Because the great Ternat bats are sometimes ob- 'served flying near the surface of the water, like the 'swallow, they have been represented as feeding upon 'fish. But this flesh is equally disagreeable to them as 'all other kinds; for, I repeat it, that they live entirely 'on vegetables. It is solely for the purpose of bathing 'that they frequent the waters; and if they fly nearer 'the surface of the water than the earth, it is owing to 'the fewer interruptions presented by the former to the 'motion of their wings. To this circumstance the 'natural cleanliness of these animals must be ascribed. 'I have seen, and I have killed numbers, and never dis- 'covered the smallest degree of dirtiness upon any of 'them.

'The great bat is by no means a beautiful animal. 'When seen nigh, its movements are all disagreeable. 'There is only one point of view, a single attitude, in 'which all its natural deformity disappears, and in which it 'may be observed with pleasure. When perched on a tree, 'it hangs with its head down, and its wings folded, and 'placed exactly on each side of the body. In this situa- 'tion the vibrating wings which constitute its deformity, 'as well as the hind paws, by the claws of which it is 'suspended, are concealed. We see only a roundish, 'plump, pendulous body, covered with deep brown hair 'extremely clean and smooth, terminated by a head 'whose physiognomy is vivacious, and by no means 'disagreeable. This is their only attitude of repose, in 'which they remain a long time during the day. They 'are seen to the best advantage at an elevation above 'the earth from forty to sixty feet, and at the distance 'of about one hundred and fifty feet. Now, figure to 'yourself a large tree, whose branches are garnished with 'one hundred and fifty or two hundred of such objects, 'having no other motion but what is communicated to 'them by the branches, and you will have an idea of a 'picture, which I have regarded as curious, and contem- 'plated with pleasure. In the richest cabinets of natural 'history the great Ternat bat is always shown with its 'wings fully extended, which is its most ugly attitude. 'This position may answer one purpose. But some of 'them ought to be viewed at a side, or from above, in 'their natural state of repose.

'I shall finish my notes by remarking, that both 'species afford a wholesome nourishment; for though 'their flesh is often devoured to excess it was never 'known to be hurtful. Neither should this fact excite 'surprise, when it is considered that these animals feed 'entirely on ripe fruits, the juices, flowers, and perhaps 'the exudations of a number of trees. The last I was 'induced to believe from a passage in Herodotus. But 'I have not been able to ascertain the truth of it by 'actual observation.'

THE SENEGAL BAT.

This bat has a long head; the nose is a little pointed; the ears are short and pointed; the head and body are

of a tawny brown mixed with ash-colour; the body is paler; the two last joints of the tail extend beyond the membrane; its length, from nose to rump, is above four inches, and the extent of the wings twenty-one inches; the membrane of the wings and tail is black.

This animal has twenty-eight teeth, two incisive in the upper jaw, six in the under, and two canine and eight grinders in each jaw. The upper cutting teeth are thick, long, and sharp, and distant from one another about a line and a half, and the under ones are furnished with lobes.

This bat was brought from Senegal by M. Adamson, of the Royal Academy of Sciences.

THE BULL-DOG BAT.

The muzzle of this bat is very thick, the lips long, and the nose well formed. The ears are broad and round, their edges touching each other under the front; they have a fold forward, which extends from the auditory canal to the edge of the concha, two lines distant from the place where the two ears touch each other, and there is a concavity on the internal face of the concha on each side of the fold. The crown and hind part of the head, the top and sides of the neck, the shoulders, the back, and the crupper, are of a brownish ash-colour. The middle of the belly is brown; the remainder of the belly, the chest, and the throat, are ash-coloured, without any mixture of brown. The membrane of the wings and tail is of a blackish brown colour. The fore legs and toes are cinereous. From the membrane there issues a portion of the tail of seven lines long, which is composed of five false vertebræ. The length of the body, from the end of the muzzle to the anus, is two inches.

This animal has twenty-six teeth, two incisive, two canine, and eight grinders in the upper jaw, and in the under jaw, two incisive, two canine, and ten grinders.

There is another bat, which seems to be of the same species with the preceding, though it differs in some articles. It is smaller, being only one inch eight lines in length. The head is not so plump, and of course the muzzle is thinner, and the nose still better shaped. The whole upper part of the body is yellow, mixed with a tinge of cinereous. The under part is of a dirty white, inclining to a yellowish ash-colour. The membrane of the wings and tail is a mixture of brown and yellow.

THE BEARDED BAT.

This bat has a head of a very singular construction. The nose has hardly any cartilage, and the front is much sunk. The nostrils are not separated, as in most animals, by a partition, but each of them is placed on the side of a small gutter, which is open above from one end to the other. The internal edge of this gutter is very small; the external is larger, and terminates in a small button. The external edges of the two gutters unite above the upper lip, and form the extremity of a large furrow, which extends from the upper lip to the front, where there is a deep naked hole, the borders of which are covered with long hair. The ears are long and narrow. The hair of the head, except that of the top, throat, breast, and belly, is whitish, with a tincture of yellow. The hair on the top and hind part of the head, the neck, shoulders, back, and rump, is of a reddish brown. The length of the longest hairs is four lines and a half. The ears and the membrane of the wings and tail have different tinctures of blackish and reddish brown. The tail is inclosed in the membrane to the very extremity. The claws are yellowish. The length of the body is about an inch and a half, and the extent of the wings a little more than seven inches.

THE STRIPED BAT.

The nose of this bat is very small. The ears are short, broad, and pointing forward. The hair of the front, top of the head, neck, shoulders, back, and rump, is of a whitish yellow colour; and that of the under jaw, breast, and belly, is blueish, with a tincture of yellow. The colour of the membrane of the wings and tail is a mixture of yellow and brown.

THE FLYING SQUIRREL.

SQUIRREL with round naked ears, full black eyes, and a lateral membrane from fore to hind legs. The hair of the tail is long, disposed horizontally, and longest in the middle. The colour above is a brownish ash, and beneath it is white tinged with yellow. It is much less than the common squirrel.

This animal is related, by certain characters only, to the squirrel, the rat, and the *loir*, or fat squirrel. It resembles the squirrel in nothing but the largeness of its eyes, and the form of its tail, which however is neither so long nor so bushy. It approaches the fat squirrel by the figure of its body, by the shortness and nakedness

of its ears, and by the hairs on its tail, which are of the same figure and length. But it is not, like the fat squirrel, subject to be reduced to a torpid state by the action of cold. Hence the flying squirrel is neither a rat, a squirrel, nor a fat squirrel, though it participates of the nature of each of the three species.

Mr. Klein gave the first exact description of this animal in the Philosophical Transactions, 1733. It was known, however, long before that time. It is found equally in all the northern regions of the Old and New Continents. But it is more common in America than in Europe, where they are rare, and confined to some northern countries, as those of Lithuania and Russia. This small animal dwells upon trees, like the squirrel. It moves about from branch to branch; and when leaping from one tree to another considerably distant, the loose skin or membrane is stretched forward by the fore feet, and backward by the hind feet. The skin being thus stretched, and drawn out laterally above an inch, augments the surface of the body, without increasing its quantity of matter, and of course retards so much the acceleration of the fall, that by a single leap the creature is enabled to sail to a considerable distance. This motion has no resemblance to the flying of birds, or the fluttering of bats, both of which are performed by striking the air with repeated vibrations. It is only a simple leap, depending on a single impulse: the motion produced by that impulse is prolonged, because the animal's body is rendered specifically lighter, is more powerfully resisted by the air, and consequently falls more slowly. The expansion of the skin from foot to foot is peculiar to the flying squirrel; and this character is sufficient to distinguish it from all other squirrels, rats and dormice. But the most remarkable peculiarities of nature are seldom confined to a single species. In the same genus there is another animal with a similar skin, which extends not only from foot to foot, but from the head to the tail. This animal, a figure and description of which is given by Seba under the name of the Virginian flying-squirrel, seems to differ so greatly from our flying squirrel as to constitute a distinct species. We cannot, however, determine the nature of this animal; it may exist, and be of a different species from our flying squirrel. But it may be a simple variety only, or perhaps an accidental or monstrous production; for it is mentioned by no traveller or naturalist. Seba is the only person who has seen it in the cabinet of Vincent. I am always suspicious of descriptions made in cabinets; for the animals in these repositories are often manufactured in such a manner as to render their appearance most singular.

We have kept the flying squirrel a long time in a living state. It has been pointed out by many travellers. It is mentioned by Sagard Theodat, Jean de Laet, Fernandes, La Honton, Denys, Catesby, Dumon, Le Page de Pratz, &c.; and good descriptions and figures of it are given by Klein, Seba, and Edwards. Our own observations with regard to this animal correspond very well with what these authors relate. It is much smaller than the squirrel. The one in our possession weighed two ounces only, which is nearly the weight of a common bat; but the squirrel weighs eight or nine ounces. Some of them, however, are larger. We have a skin of a flying squirrel, which, from its dimensions, must have belonged to a larger animal than the ordinary kind.

[The hair of the flying squirrels is blacker than in the French squirrels. Their wings extend from the fore to the hind feet, are about two inches broad, very thin, and covered with fine down. Their flight seldom exceeds thirty or forty paces; but if they fly from tree to tree, double these distances will be necessary.—*Descript. Geog. d'Amérique Septent.*

In Louisiana two species of squirrels are very common; the one is entirely similar to those of France, the other has a little more of the ash-colour, and between the two fore feet there is a membrane, by means of which it springs from one tree to another at considerable distances.—*Mem. sur la Louisiane.*

The flying squirrels have received their denomination from their faculty of leaping from one tree to another, at the distance of above twenty-five or thirty feet. Their hind feet are connected to the fore feet by a membrane, which supports them in the air when they leap. They seem to fly; but they sink lower down, &c.—*Hist. de Louisiane.*]

The membrane, or expansion of the skin, which unites the fore and hind legs of the flying squirrel, and supports it in the air, makes it approach to the bat. It also resembles the bat in its natural disposition; for it reposes and sleeps during the day, and resumes its activity in the evening. It is easily tamed; but it is subject to become enraged, and must be kept in a cage, or restrained by a small chain. Flying squirrels are fed with bread, fruits, and seeds. They are particularly fond of the buds and young shoots of the pine and birch trees. They search not for nuts and almonds like the squirrels. They make a bed of leaves, in which they sleep during the whole day, and never depart from it till night when stimulated by hunger. As they have little activity they become an easy prey to pine weasels and other animals which climb trees; and of course the species is not numerous, though the females generally bring forth three or four young at a time.

SUPPLEMENT.

THE SAILING OR GREAT FLYING SQUIRREL.

I formerly remarked, that there were larger flying squirrels than those of which we have given descriptions, and that there is in the royal cabinet a skin five and a

half inches long, while that of the common species exceeds not four inches. But this difference is nothing when compared to that which subsists between our flying squirrel and the East India *taguan*, whose skin was sent from Machian to the Prince de Condi, who was so obliging as to allow me to examine it. This great flying squirrel, which is preserved in the cabinet of Chantilly, was twenty-three inches long from the point of the nose to the extremity of the body. These animals are found not only at Machian, but in the Philippine islands, and probably in many other parts of India. The one just mentioned was taken on the Malabar coast. Its size is gigantic, when compared with the flying squirrels of Russia and America; for the latter exceeds not four and a half or five inches in length. Nevertheless, the taguan, or great flying squirrel, resembles the other species in figure and in the prolongation of the skin, which is perfectly similar. But as the difference of size is so remarkable it ought to be considered as a distinct species.

The great flying squirrel differs from the small. 1. In size, being twenty-three inches long. 2. In the length of the tail, which is twenty-one inches. Besides, the tail is not flat like that of the common kind, but round, like that of the cat, and covered with long blackish brown hair. 3. The eyes and ears of both species are similarly situated, and the black whiskers are proportionally the same; but the head of the large kind is smaller in proportion to the size of its body. 4. The face is entirely black; the sides of the head and the cheeks are mixed with black and white hairs; on the top of the nose and round the eyes, the hair is a mixture of black, white, and red. Behind the ears there are dark long brown hairs, which cover the sides of the neck; these are not to be found in the common kind. The top of the head and of the whole body, as far as the tail, is sprinkled with black and white hairs, where the black predominates, because the white hairs are black at the roots, and become white near their extremities only. The under part of the body is of a dirty white colour, which extends below the belly. 5. The prolongation of the skin is covered above with dark brown hair, and below with yellowish ash-coloured hair. The legs are of a reddish black colour, and the upper part of the tail is brown. This brown shade grows gradually deeper till it becomes black at the extremity of the tail. 6. The feet of the great flying squirrel have the same number of toes as in the common kind; but those of the former are covered with black, and those of the latter with white hair. The claws are thin and hooked, like those of a cat. From this resemblance, and that of the tail, the animal has received the name of the flying cat. The large claw of the fore feet is five lines and a half long, and the longest of the hind feet only five lines. We have called this animal *le taguan*, in consequence of the following passage in the general history of voyages.

'In the Philippine islands there is a species of flying 'cat, of the size of a hare, and of the colour of a fox, 'which the natives call *taguan*. It has wings like a 'bat, but covered with hair, which they make use of in 'leaping from one tree to another at the distance of 'thirty palms.'

After writing this article, a work of M. de Vosmaer, containing descriptions of several quadrupeds and birds, has come to my hands. I there read with pleasure the description of the great flying squirrel, and some remarks concerning the smaller species.

M. de Vosmaer informs us, that he saw in the possession of the Prince of Orange two of the small flying squirrels alive; but that they did not live long.

'They slept,' he says, 'almost the whole day. When 'briskly pushed, they made a small effort as if they 'intended to fly; but they stole away immediately, being 'exceedingly timid. They are fond of heat; and when 'uncovered, they quickly concealed themselves under 'the wool which formed their bed. Their food was 'soaked bread, fruits, &c. which they eat, like the 'squirrels, by sitting on their posteriors, and holding 'the food with their fore paws. At the approach of 'night they become more vivacious and restless. The 'difference of climate had unquestionably great influence 'on these animals, which appeared to be extremely 'delicate.'

These remarks of M. de Vosmaer correspond with my own observations. I have just now one of these little animals (March 17, 1775) living in a cage with a small box in its bottom. It continues the whole day covered with the cotton, and comes out in the night only to take food. It has a faint cry, like that of a mouse, which is never heard but when the animal is forced out from among the cotton. Though its teeth are very small it bites severely. Its hair is extremely smooth and agreeable to the touch. There is no way of making it extend its wings but by obliging it to fall from a height. It is so remarkably chilly that I cannot conceive how it can defend itself from the cold in the northern climates; since in France, if not kept in a chamber, and furnished with wool or cotton to lie on, and even to wrap itself all over, it would perish in a very short time.

With regard to the taguan, or great flying squirrel, let us attend to the remarks of M. de Vosmaer: 'The 'small flying squirrel described by M. de Buffon, has a 'great affinity to the larger species. They both have 'similar membranes, not for flying, but for supporting 'themselves in the air when they leap from branch to 'branch.

'The skin of the great flying squirrel, which is a more 'proper appellation than that of the flying cat, was sent 'me in a dried state. M. Alamand has given a short

'description of this animal from a female subject preserved in the cabinet of the Leyden academy.

'Valentine first mentioned these animals, and says, 'that they are found in the island of Gilolo, and go by 'the name of flying civets. He remarks, that they have 'long tails, like those of the monkeys; that when at 'rest their wings are not seen; that they are wild and 'timid; that their head is reddish, with a mixture of 'gray; that their wings, or rather membranes, are 'covered on both sides with hair; that their bite is so 'strong that they easily escape from a wooden cage in 'a single night; that by some people they are called 'flying monkeys; that they are also found in the island 'of Ternat, where they were first mistaken for squirrels, 'only the head was thinner and larger; there was gray 'hair above the muzzle, and a black line run the whole 'length of the back; that the extensible skin, which 'adheres to their bodies, is garnished with hair as white 'on the under side as that of the belly; and that when 'they leap from tree to tree they extend their membranes, and have then the appearance of being flat.'

In the work of M. l'Abbé Prevost, it is said, that this animal is found in the Philippine islands, where it is called *taguan*.

'I have seen two females, the one in the Leyden 'cabinet, the other in that of M. Heeteren at the Hague. 'The colour of the body was a light chesnut, deeper on 'the back, and the end of the tail was blackish. The 'difference of sex is distinguishable by six small paps, 'placed at equal distances, in two rows, from the breast 'to the belly. I have also seen two males in the Prince 'of Orange's cabinet. The length of the body, in Rhenish measure, was one foot five inches, and that of the 'tail one foot eight. The head is more pointed than 'that of the squirrel.

'The ears are small, pointed, and covered on the outside with short, fine, clear brown hair. Above the 'eyes there are two long brownish yellow hairs; but 'there are none on the eye-lids. On each side of the 'muzzle there are long, black, rigid whiskers. The 'nose is naked; the teeth, like those of the squirrels, 'are two above and two below, of a deep yellow colour, 'and very long. The grinders are at the bottom of the 'muzzle.

'Both fore and hind feet, especially the latter, are 'concealed by the membrane, which covers them nearly 'as far as the paws. The fore feet are divided into four 'black toes, the two middlemost, and particularly the 'third, being much longer than the other two. The 'hind feet are also black, and divided into five toes, 'four of which are of equal length; but the fifth or 'innermost is much shorter, and has the appearance of 'a simple appendage. The claws are large, sharp, black 'before, white below, and broad at the origin. The 'articulations of the toes are similar to those of the 'squirrels.

'The skin or membrane is thinnest in the middle, 'where it is about four inches broad on each side, and 'exceeds not the thickness of fine Indian paper. In 'other parts it is also very thin, of a clear texture, and 'garnished with small chesnut hairs. Near the fore and 'hind feet it becomes thicker, and rises in the form of 'a bag, widest at the thighs, and growing gradually 'narrower towards the paws. This part is closely covered 'with brown and black hairs. Upon the fore paws it 'appears loose, hangs down like a rag, and is covered 'with thick hair. The external edges of this skin are 'bounded with a thick selvage of black and gray hairs.

'The upper part of the head, the back, and the origin 'of the tail, are covered with pretty long thick hairs, 'black in the under part, and mostly of a grayish white 'colour at the summits.

'The hairs of the tail are black, more gray near the 'body, and so disposed as to make the tail appear 'round.

'The cheeks are of a grayish brown colour; and the 'throat, breast, and belly, are of a clear whitish gray. 'On the under side of the membrane there are also gray 'hairs; but they are very thinly scattered.'

THE GRAY SQUIRREL.

THE ears of the gray squirrel are plain; the hair is of a dull gray colour, mixed with black, and often tinged with a dirty yellow. The belly and insides of the legs are white. The tail is long, bushy, gray, and striped with black. It is about the size of a half-grown rabbit.

This animal inhabits the northern regions of both worlds. It has a great resemblance to the squirrel, from which it differs only by the following external characters. It is larger than the squirrel, and its hair is not reddish, but of a gray colour more or less deep. The ears are deprived of the long hairs which adorn those of the common squirrel. These differences, which

are constant, seem sufficient to constitute a distinct species. Several authors maintain, that the gray squirrels of Europe differ from those of America; that the former belong to the common kind, whose colour changes with the season in our northern climates. Without pretending to deny this last fact, which, however, is not properly ascertained, we consider the gray squirrel of Europe and that of America as the same animal, and as a species distinct from the common squirrel; for our squirrels are found in North America as well as in the north of Europe. They are of the same size, and their colour is of a more or less lively red, according to the temperature of the climate. At the same time we find in both continents other squirrels, which are larger, and whose hair is gray or blackish in all seasons. Besides, the fur of the gray squirrel is much finer and softer than that of the common kind. Hence it appears, that these two animals, the differences between which are constant, and their species, though similar, have never intermixed, ought to be regarded as separate species. M. Regnard affirms positively, that the gray squirrels of Lapland are the same animals with our French squirrels. This authority would be sufficient, were it not contradicted by other evidences. M. Regnard has written some excellent theatrical works; but he was not much versant in natural history: neither did he remain long enough in Lapland to see the squirrels change their colour. It is true, that some naturalists, and among this number is Linnæus, tell us, that in the northern regions the squirrels change their colour in winter; which is not improbable, as in these climates hares, wolves, and weasels also change their colours. But this change is from yellow or red to white, and not from yellow or red to an ash-colour. But to confine ourselves to the squirrel, Linnæus, in the *Fauna Suecica*, says, *æstate ruber, hyeme incanus*. The change, therefore, is from red to white, or rather from reddish to whitish; and it is not easy to conceive why Linnæus, in the last edition of his *Systema Naturæ*, should have substituted in the place of *incanus* the word *cinereus*. M. Klein assures us, on the contrary, that the squirrels in the neighbourhood of Dantzick are reddish in winter as well as in summer; and that there are in Poland gray and blackish squirrels as well as the reddish kind, which never change their colour. These gray and blackish squirrels are found in Canada, and in all parts of North America. Hence the gray squirrel may be regarded as an animal common to both continents, and of a different species from the ordinary squirrel.

[The gray Lapland squirrels are the same as the French, only their reddish colour changes to gray during the winter snows. The farther north they turn always more gray. The Laplanders make war against them in the winter; and their dogs are so well trained to this species of hunting, that they never failed to discover the squirrels upon the highest trees, and to advertise the hunters who accompanied us. We shot some of them with our guns; for the Laplanders had not then their round arrows with which they bring down these animals; and we had the pleasure of seeing with what dexterity and quickness they take off the skin. The hunting season begins about Michaelmas. Almost every native of Lapland is occupied in this business, which is a considerable article of commerce. Forty skins are sold for a crown. But there is no merchandise in which a man may be more deceived than in that of the gray squirrel and ermines; for you buy without seeing, the fur side of the skins being always turned inmost. There is no distinction to be made. The good and bad are all sold at the same price. We learned from our Laplanders a surprising fact concerning these gray squirrels, which was afterwards confirmed by our own experience. They often change the places of their residence, and not one of them can be found during the whole winter where there were millions the preceding year. In their marches from one part of the country to another, when it becomes necessary to pass a lake or a river, which are very frequent in Lapland, these animals lay hold of a piece of pine or birch bark, which they draw to the edge of the water, mount upon it, and abandon themselves to the pleasure of the wind and waves. They erect their tails in the form of sails; but if the wind blows too strong, or the waves rise high, both pilot and vessel are overturned. This kind of shipwreck, which often consists of three or four thousand sail, generally enriches some Laplanders, who find the dead bodies on the shore, and if they have not lain too long on the sand, prepare the furs in the ordinary manner. But when the winds are favourable the poor creatures make a happy voyage, and arrive at their destined port. This remarkable fact might have the appearance of a fable, if it had not fallen within my own observation.—*Œuvres de M. Regnard.*]

Besides, we never see our squirrels, though very numerous in the forests, unite together in flocks. Neither do we ever see them travel in company, approach the waters, or traverse rivers on the bark of trees. Thus they differ from the gray squirrel, not only in size and colour, but in manners and habits; for, though the navigations of the gray squirrel seem to be hardly credible; yet they are attested by such a number of witnesses that we cannot say absolutely that they are false.

Of all the wild quadrupeds the squirrel is subject perhaps to the greatest varieties, or whose species at least is approached by the greatest number of neighbouring species. The white squirrel of Siberia appears to be only a variety of the common kind. The black and the deep gray squirrels of America may be varieties of the gray squirrel. The Barbary, the palm, and the

ground squirrels, are three species which make a very near approach to each other.

We have few historical facts concerning the gray squirrel. Fernandes remarks that the gray or blackish squirrels of America dwell upon trees, and particularly upon the pine; that they feed upon fruits and seeds; that they amass provisions for the winter, which they deposit in the holes of trees, where they also retire to pass the severe season; that in these holes the females bring forth their young, &c. Thus the manners of the gray squirrel differ from those of the common kind, who build nests, like the birds, on the tops of trees. We cannot, however, pretend to determine absolutely that this blackish squirrel of Fernandes is the same with the gray squirrel of Virginia, or that both of them are the same with the gray squirrel of Europe. We only mention it as a probability; for these three animals are nearly of the same size and colour, inhabit the same climates, have precisely the same figure, and their skins are equally used under the denomination of the gray fur, or the fur of the gray squirrel.

THE PALM SQUIRREL, THE BARBARY SQUIRREL, AND THE GROUND SQUIRREL.

THE palm squirrel has plain ears, an obscure pale yellow stripe on the middle of the back, another on each side, a third on each side of the belly, the two last being very distinct. The rest of the hair on the sides, back, and head, is black and red very closely mixed; that on the thighs and legs is more red. The belly is of a pale yellow. The hair on the tail does not lie flat, but encircles it; it is coarse, and of a dirty yellow, barred with black.

The Barbary squirrel has full black eyes and white orbits. The head, body, feet, and tail, are cinereous, inclining to red. The colour is lightest on the legs. The sides are marked lengthwise with two white stripes. The belly is white. The tail is bushy, marked regularly with shades of black, one beneath another. It is of the size of a common squirrel.

The ground squirrel has plain ears. The ridge of the back is marked with a pale yellow stripe, bounded above and below with a line of black. The head, body, and tail, are of a reddish brown colour; the tail is darkest. The breast and belly are white, and the nose and feet pale red. The eyes are full.

The palm squirrel is of the size of a rat, or of a small squirrel. He lives upon the palm-trees, and from that circumstance he has acquired his name. By some he is called the palm-rat, and by others the palm squirrel. But as he is neither a rat nor a squirrel, we have given him the simple denomination of *le palmiste*. The form of his head is nearly the same with that of the short-tailed field-mouse, and covered with frizzled hair. His long tail trails not, like that of the rat, but is elevated vertically, without, however, lying on his back, like that of the squirrel. The tail is covered with hair longer than that of the body, but shorter than the hair on the tail of a squirrel. Along the spine of the back, from the neck to the tail, there is a whitish stripe, accompanied on each side with a brown stripe, which is followed by another white stripe. This striking character, by which this animal would appear to be distinguished from all others, is found to be nearly the same in the Barbary and ground squirrels. These three animals have such a resemblance to each other, that Mr. Ray imagined they constituted but one species. If it be considered, however, that the palm and Barbary squirrels are only found in the warm climates of the Old Continent, and that the ground squirrel described by Lister, Catesby, and Edwards, is peculiar to the cold and temperate regions of the New World, we must conclude them to be different species. By a closer examination we perceive that the white and brown stripes of the ground squirrel are differently disposed from those of the palm-squirrel. In the palm squirrel, the white stripe, which extends along the spine of the back, is black or brown on the ground squirrel, and the white stripes are placed next the black, as the black are next the white in the palm-squirrel. Besides, the palm-squirrel has only three white stripes; but the ground-squirrel has four. The latter turns his tail upon his back, but the former does not. The palm-squirrel dwells upon trees; but the ground squirrel keeps always on the surface of the earth, and from this circumstance he has obtained his name. In fine, the ground-squirrel is smaller than the palm-squirrel: from all these considerations they appear to be two distinct species.

With regard to the Barbary squirrel, as it is a native of the same continent and climate, as it is of the same size, and nearly of the same figure, with the palm-squirrel, they might be considered as varieties of the

same species. By comparing, however, the description and figure of the Barbary squirrel given by Caius, and copied by Aldrovandus and Johnston, with the description we have given of the palm-squirrel, and by again comparing Edwards's description and figure of the Barbary squirrel, we shall perceive distinctions so remarkable as to point out these animals as belonging to different species. All the three are in the royal cabinet. In the Barbary squirrel the head and face are rounder, the ears larger, and the hair of the tail longer and more bushy than in the palm-squirrel. In the form of the head and body the Barbary squirrel resembles the squirrel more than the rat, and the palm squirrel resembles the rat more than the squirrel. The Barbary squirrel has four white stripes, and the palm-squirrel only three. In the palm-squirrel the middle white stripe runs along the spine of the back; but in the Barbary squirrel the stripe along the back is black mixed with red, &c. Besides, these animals have nearly the same manners and dispositions as the common squirrels: they all feed upon fruits, which they carry to their mouth by their fore-paws. They have the same voice and cry, the same instinct and agility. They are extremely gentle and lively. They are easily tamed, and contract such an attachment to their habitation, that after leaving it they spontaneously return. The figure of both is handsome. Their robe, which is striped with white, is more beautiful than that of the squirrel; their size is smaller, their body lighter, and their movements equally prompt. Like the common squirrel, the palm and Barbary squirrels dwell on the tops of trees; but the ground squirrel never rises from the earth, in which, like the long-tailed field mouse, he makes a retreat impenetrable by the water. Unless completely tamed he bites every person indiscriminately. Hence in manners and dispositions he has a greater resemblance to the rats and field-mice than to the squirrels.

THE GREAT ANT-EATER, THE MIDDLE ANT-EATER, AND THE LEAST ANT-EATER.

THE great ant-eater has a slender nose, small black eyes, short round ears, a slender tongue, two feet and a half long, which lies double in the mouth; slender legs, four toes on the fore feet and five on the hind. The two middle claws on the fore feet are very large, strong, and hooked. The hair on the upper part of the body is half a foot long, black mixed with gray. From the neck cross the shoulders to the sides there is a black line bounded above with white. The fore legs are whitish, marked above with a black spot. The tail is clothed with very coarse black hairs a foot long. The length from nose to tail is about three feet ten inches, and that of the tail is two feet and a half.

The middle ant-eater has a long slender nose, bending a little down, small black mouth and eyes, and small upright ears. The bottoms of the fore feet are round, with four claws on each, and five on the hind feet. The hair is shining, hard, and of a pale yellow colour; along the middle of the back, and on the hind legs, it is dusky. On each side of the neck there is a black line, which crosses the shoulders, and meets at the end of the back. The tail is covered with longer hair than the back, is taper, and bald at the end. The length from nose to tail is one foot seven inches, and that of the tail ten inches.

The least ant-eater has a conic nose, bending a little down; small ears hid in the fur; two hooked claws on the fore feet, the exterior much the largest, and four on the hind feet. The head, body, limbs, and upper part and sides of the tail are covered with long, soft, silky hair, or rather wool, of a yellowish brown colour. The length, from nose to tail is seven inches and a half, and that of the tail eight and a half, the last four inches of which on the under side are naked. The tail is thick at the base, and tapers to a point.

In South America there are three animals, with a long muzzle, a narrow mouth without any teeth, and a long round tongue, that they thrust into the ant nests, and retract when covered with these insects, which constitute their principal food. The first of these ant-eaters is called by the Brasilians *tamandua-guacu*, or great *tamandua*, to which the French inhabitants of America have given the name of *tamanoir*. From the end of the muzzle to the origin of the tail it is about four feet in length. The head is from fourteen to fifteen inches long, and the tail about two feet and a half, covered with coarse hair more than a foot in length. The muzzle is immoderately long, the neck short, the head narrow, the eyes small and black, the ears roundish, the tongue thin, more than two feet long, and when retracted it folds up in the mouth. The legs exceed not a foot in length, those before being a little longer and thinner than those behind. The feet are round. The fore feet have four claws; and the two middlemost are largest. Those behind have five claws. The colour of the hairs,

both on the body and tail, is a mixture of black and white. The hair on the tail is disposed in the form of a plume, which the animal, when he wants to sleep, or to defend himself from rains or the heat of the sun, turns on his back, and it covers his whole body. The long hairs of the tail and body are not round through their whole extent, but flat at the extremities, and feel dry to the touch like withered herbs. When irritated he gives a brisk agitation to his tail; but when walking at ease he allows it to trail and sweep the ground over which he passes. The hair on the anterior parts of his body are shorter than those on the posterior: the latter are turned backward, and the former forward. The anterior parts are also whiter than the posterior. There is a black stripe upon the breast, which stretches along the sides, and terminates on the back near the thighs. The hind legs are nearly black, and those before almost white, with a large black spot about the middle. The great ant-eater runs so slow that a man can easily overtake him in the chase. His feet seem less fitted for running than for climbing, and seizing cylindrical bodies; for he takes such a forcible hold of a branch or a stick, that it is impossible to make him quit it.

The second of these animals, or the middle ant-eater, is called simply *tamandua* by the Americans. He is much smaller than the former, being only about eighteen inches from the extremity of the muzzle to the origin of the tail. His head is six inches in length. His muzzle is long, and crooked downward. The tail is ten inches long, and naked at the point. The ears are erect, and an inch in length. The tongue is round, eight inches long, and placed in a kind of groove or canal within the lower jaw. The height of the legs exceeds four inches; and they are of the same form, and furnished with the same number of claws, as the great ant-eater. He climbs, and adheres firmly to the branches, like the former species, and runs or walks equally ill. Neither can he shelter himself with his tail; because it is too short, and part of it is bare. When he sleeps, he conceals his head under his neck and fore legs.

The third species is called by the natives of Guiana *ouatiriouaou*. To distinguish it from the two former, we have given it the appellation of the least ant-eater. It is much smaller than the middle kind; for it exceeds not six or seven inches from the extremity of the muzzle to the origin of the tail; the head is two inches long, and the muzzle is proportionally shorter than that of the middle ant-eater. The tail, which is seven inches in length, curls downward at the extremity, where it is naked. The tongue is narrow, a little compressed, and very long. It has almost no neck. The head is thick in proportion to the body. The eyes are placed low, at no great distance from the corners of the mouth. The ears are small, and concealed by the hair. The fore legs are only three inches long, and their feet have but two claws, the outmost of which is much thicker and longer than the inmost. There are four claws on the hind feet. The hair on the body is about nine inches long, soft, and of a brilliant colour, being a mixture of red with a bright yellow. The feet are not fitted for walking but for climbing, and laying hold of objects. The animal mounts upon trees, and suspends himself on the branches by the extremity of his tail.

Of this genus we know only the three species above described. M. Brisson mentions from Seba a fourth species, under the name of the long-eared ant-eater. But this species seems to be extremely suspicious; for in Seba's enumeration of the ant-eaters he says expressly, 'We have in our cabinet six species of ant-eaters.' He describes, however, only five; and among these five he places the *ysquiepatl*, or stifling weasel, an animal not only of a different species, but of a genus very remote from that of the ant-eaters; since it has teeth, a flat short tongue, like that of other quadrupeds, and approaches very near to the weasel kind. Of these six species, pretended to be preserved in the cabinet of Seba, there remain only four; for the ysquiepatl, which is the fifth, is by no means an ant-eater, and he makes no mention of the sixth, unless the author intended to rank the scaly lizard under this genus, which appears not from his descriptions. The scaly lizard feeds upon ants; he has a long muzzle, a narrow mouth, without any apparent teeth, and a long, round tongue. These characters are common to the scaly lizard and ant-eaters. But the former differs from all other quadrupeds by the singularity of having its body covered with large scales instead of hair. Besides, it is an animal peculiar to the warm climates of the Old Continent; while the ant-eaters, whose bodies are covered with hair, are found only in the southern regions of the New World. There remains therefore but four species instead of six announced by Seba; and of these four only one is recognisable from his descriptions, which is our third or least ant-eater, to whom Seba has given but one claw to each fore foot instead of two.

[The head is much shorter, and the ears much smaller. The eyes are a little larger, and the inferior part of the muzzle somewhat longer. Their tongues are more similar, both of them being fitted for swallowing ants. The shoulders are large, the body thick and short, and the fore feet are armed with one large hooked claw. The hind legs and feet resemble those of an ape. Its white woolly hair is shorter than that of the preceding; and the same may be said of its crisped tail. This animal is reckoned the rarest of its species. The negroes of Surinam called it *coati*, and relate, that when apprehended it rolls itself up with the feet so closely attached to each other, that it is impossible to force them asunder. It dies in a moment when immersed in spirit of wine, or in the liquor *kilduivel*.—*Seba*.]

The other three are so ill described that it is impossible to distinguish their true species. I thought it proper to transcribe these descriptions entire, not only to prove what I have advanced, but to give an idea of what credit is due to this writer. The animal he calls *tamandua murmecophage d'Amerique*, has no relation to any of the three of which we are here treating. To be convinced of this fact we have only to read the author's description.

[*Tamandua murmecophage d'Amerique.*—This animal is very common in the West Indies; but the only one we have seen was brought from the East Indies. Several naturalists have entertained marvellous ideas concerning this creature. Some imagined it to be the *leo formicarius*, others the *formica leo*, the *formica vulpes*, the *formica lupus*, &c. M. Poudart, in the *Mem. de l'Acad. ann.* 1704, remarks, that this animal was gray, and made snares, like a spider for entangling ants; but this comparison seems not to be just. Bastamantanus, who has written a book upon the reptiles mentioned in the Bible, regards the *murmeco leo*, another name for this animal, as a species of beetle called the horned beetle, which is denominated the flying stag by the Germans. (All this, we perceive, is very important and very useful in the description of a quadruped.) But, continues the author, all these descriptions, and several others, express not the nature of this animal, the figure of which we have given from the original. It is covered with foft woolly hair, has a short neck, broad shoulders, a long narrow head and muzzle, from which issues a long tongue, adapted for seizing and swallowing ants. The wisdom of the Creator has furnished these animals with the necessary organs for collecting food agreeable to their taste. The fore paws have each, beside the ordinary toes, three other toes, which have grown above the others, and are armed with hooked claws, the largest of which is on the middle toe. It is with these that they scrape the earth, and pierce the ants nests. The nostrils, which are placed very near the mouth, are strait, rough, and furnished with hair. They discover the retreats of the ants by the scent. The ears are oblong, or pendulous. The hind feet, as in the bear, are divided into five toes, armed with long crooked claws. The tail, which is long and bushy, terminates in a point, and they use it, like the monkeys, in fixing themselves to the branches of trees. The testes of the males are concealed within the skin. The ants, both large and small, become a prey to these animals, which, in their turn, are used by men as a medicine.—*Seba*, vol. i. p. 60.

From such a description nothing can be learned: to apply it to the ant-eaters, as Linnæus has done, to give, at the same time, this animal three toes on the fore feet, besides the ordinary three, and to make these grow above the others, are absurdities so glaring as to throw discredit upon the whole narration.]

The second, he mentions under the name of the *tamandua-guacu* of Brasil, or the bear which eats the ants. This is vague and equivocal language.

[*Tamandua-guacu*, of Brasil, or the bear that eats the ants. This is the largest species we have ever seen. Marcgrave calls it *tamandua-guacu*, and Cardan, *ursus formicarius*, or the bear that eats the ants. The body is long; the shoulders are broad and high; the head is very long; the muzzle gradually tapers to a point; and the nostrils are large and open: the tongue, which it thrusts out to seize the ants, about the eighth part of a cubit, terminates in a round button. The ears are long and pendulous. The eyes are pretty large, and defended by thick hairs. The muzzle is long, wrinkled, and garnished with hair. The rest of the body is covered with long thick hairs, similar to hogs bristles, but become fine and woolly near the skin, and their colour is a bright chesnut. The hair on the belly is of a deeper brown. Under the tail, which is long, and terminates in a point, the colour of the hair is a bright yellow. The female has eight paps, three on each side of the belly, and two between the fore feet. Witnesses worthy of credit relate, that the females bring forth at every litter as many young as they have paps, in which they resemble the swine, who never bring forth many at a time, unless they have a great number of paps. Both the fore and hind feet are larger than those described in fig. 2. of the preceding table. They use for food the largest kinds of ants.

We have in our cabinet six species of ant-eaters, who all differ from each other in the figure of the body, head, feet, and claws. The tamandua represented in fig. 2. (*Note*—He is here speaking of the ysquiepatl, which differs more from the tamandua than a cat from a dog) is a fourth part less than the former; its head, ears, and eyes, are also smaller. His fore foot has only a single claw, which is strong and hooked. The hind foot has three toes and three claws. The hair is soft, woolly, and coloured like that of a young hare. The figure of the fifth species of tamandua is the same. The colour of the hair is a pale red on the back, mixed with a silvery white, and a yellowish ash-colour on the belly. This species has four paps, two under the fore and two under the hind legs. (This species, being of the same figure with that which precedes it, must therefore be a species of ysquiepatl, and not of the tamandua.) The sixth species has a longer muzzle, and ears erect like those of the fox. None of these species have teeth.—*Seba*. It is impossible to comprehend what the author says, or what he means by the sixth species. We only perceive that he clearly contradicts himself when he tells us, that none of these species have teeth, since the ysquiepatl, which is *nominatim* included among the six, has a great number of teeth. From such examples we may form a judgment of this author and his work. It is a

subject of regret that men who make cabinets of natural objects are not better informed, and that, to gratify their insignificant vanity, and enhance the value of their collections, they undertake the publication of descriptions, which are always replete with such numerous exaggerations and blunders, that the correction of them would require more time than the authors bestow on the composition of their voluminous works.]

I agree with Klein and Linnæus, that it may be the true tamandua-guacu, or great ant-eater; but so miserably described and represented, that Linnæus has united under one species Seba's first and second animals. M. Brisson has considered the last as a distinct species; but I know not whether the establishing of this species be better founded than the reproach he throws upon M. Klein for confounding it with that of the great ant-eater. The only reproach which M. Klein seems to merit is for adding to a good description that he has given of this animal the false remarks of Seba. In fine, the third of these animals, of which we find a figure in Seba, is so ill described, that notwithstanding my confidence in the judgment of M. Linnæus and Klein, this animal, from Seba's figure and description, can never be referred to the *tamandua-i*, or middle ant-eater. I would beg of them to peruse the description a second time, and then form their judgment.

[*The little American tamandua, or the ant-eater delineated along with a nest of these insects.* See how it embraces with its fore claws the nests of ants upon which alone it feeds. Observe its oblong, thin, narrow head, its short ears, its pointed muzzle, that conceals its long slender tongue, with which it catches and swallows the ants, as I propose to show in the following plates (no such plates appear in his work.) The head, legs, feet, tail, and the fore part of the body, are straw-coloured. The hind part of the body is reddish brown. Upon the breast there is a belt of silky hair, which gradually disappears about the middle of the back. The tail is short, almost naked, and curled inward.—*Seba. Note*—The last characters in this description agree pretty well with the tamandua; but, in general, it is so incorrect that it determines nothing.]

Discussions of this kind are always disagreeable, but they often cannot be avoided in details of natural history. Before describing an object we must clear it, as far as possible, from all obscurities, and mark the numberless errors that obstruct the road to truth, at which it is often difficult to arrive.

From this critical examination one thing appears to be certain, that three species of ant-eaters actually exist; that these three are the great, the middle, and the least ant-eater, or the *tamanoir*, the *tamandua*, and the *fourmiller;* and that the fourth species, mentioned by M. Brisson, under the name of the long-eared ant-eater, is very doubtful, as well as the other species described by Seba. We have seen the great and the least ant-eater; their skins are in the royal cabinet, and they are very distinct species. But we never have seen the middle kind. Our description of it shall be taken from Piso and Marcgrave, the only authors who ought to be consulted concerning this animal, because all others have copied from them.

As to size of body the *tamandua*, or middle ant-eater, may be considered as a mean proportional between the great and the least kind. Like the great ant-eater he has a long muzzle, and four toes on the fore feet; but, like the least kind, his tail, by which he hangs on the branches of trees, is naked at the extremity. Both kinds, when suspended on a branch, balance their bodies, stretch their muzzles towards the hollows they discover in trees, thrust in their long tongues, and quickly retract them, in order to swallow the insects they have collected.

These three animals, which are so different in size and proportions of body, have many common qualities both in their structure and manners. They all feed upon ants, and plunge their tongues into honey, and other liquid or viscid substances. They readily pick up crumbs of bread, or small morsels of flesh. They are easily tamed. They can subsist a long time without any food. They never swallow all the liquor which they take for drink; for a part of it falls back through the nostrils. They generally sleep during the day, and move about in the night. They run so slowly that a man may easily overtake them in an open field. Their flesh, though its taste be very disagreeable, is eaten by the savages.

At a distance the great ant-eater has the appearance of a fox, and for this reason some travellers have given him the name of the American fox. He has strength sufficient to defend himself against a large dog, or even the *jaguar* or Brasilian cat. When attacked, he at first fights on end, and, like the bear, annoys the enemy with the claws of his fore feet, which are very terrible weapons. He then lies down on his back, and uses all the four feet; in which situation he is almost invincible, and continues the combat to the last extremity: even when he kills his enemy he quits him not for a long time after. He is enabled to resist better than most animals, because he is covered with long bushy hair, his skin is remarkably thick, his flesh has little sensation, and his principle of life is very tenacious.

All the three ant-eaters are natives of the warm climates of America, as Brasil, Guiana, the country of the Amazones, &c. None of them are to be found in Canada, or the northern regions of the New World, and therefore should have no existence in the Old Continent. Kolbe and Desmarchais, however, mention these animals as natives of Africa; but they seem to have confounded the scaly lizard with the ant-eaters. Marcgrave certainly never saw this animal in Africa, since he acknowledges, that even in America he never saw more

than stuffed skins of it. Desmarchais says simply, that the great ant-eater is found both in Africa and America, without adding a single circumstance in proof of the fact. With regard to Kolbe no dependence can be had on his testimony; for a man who saw at the Cape of Good Hope elks and lynxes perfectly similar to those of Prussia might also see the ant-eater in that climate. The ant-eaters are never mentioned by any author among the natural productions of Africa and Asia. But all the travellers, and most of the historians of America, take particular notice of these animals. De Lery, de Laet, le P. d'Abbeville, Maffë, Faber, Nieremberg, and M. de la Condamine, agree with Piso, Barrere, &c. that the ant-eaters are natives of the warm climates of America. We must therefore conclude that Desmarchais and Kolbe have been deceived, and that these animals exist not in the Old Continent.

SUPPLEMENT.

THE GREAT ANT-EATER.

Dr. Maudhuit, a learned naturalist and physician, has sent us from Guiana a well preserved specimen of the great ant-eater, which, though precisely the same species with that formerly described, has a shorter muzzle. The distance between the eye and ear is likewise less, and the feet are shorter. On the fore feet there are four claws; the two middlemost being very large, and the two outermost very small. The hind feet have five black claws. The muzzle, as far as the ears, is covered with short brown hair. About the ears the hair begins to grow longer; upon the sides of the body it is two inches and a half in length, and as hard to the touch as that of the wild boar. The colour of the hair is a mixture of deep brown and a dirty white. This animal is three feet eleven inches long.

M. de la Borde, king's physician at Cayenne, has communicated the following observations regarding this animal.

The ant-eater inhabits the woods of Guiana, where 'there are two species. The individuals of the largest 'kind sometimes weigh one hundred pounds. They run 'more slowly and sluggishly than the hog. They swim 'across large rivers; and on these occasions it is easy 'to knock them down with a stick. In the woods they 'are shot with muskets. They are not very common; 'and the dogs refuse to hunt them.

'The great ant-eater tears up with his claws the nests 'of the wood-lice, that are every where to be found on 'the trees, which he climbs with ease. It is dangerous 'to come near this animal; for his claws inflict the 'most dreadful wounds. He defends himself with suc-'cess against the most ferocious animals of this conti-'nent, as the jaguars, couguars, &c. whom he tears with 'his claws, the muscles and tendons of which are very 'strong. He kills many dogs, and therefore they refuse 'to hunt him.

'The great ant-eater is often seen in the large uncul-'tivated savannahs. He is said to feed upon ants. In 'his stomach, which is larger than that of a man, I 'found a vast number of wood-lice that had been recently 'swallowed. The structure and dimensions of his tongue 'seem to indicate, that he may likewise feed upon ants. 'The female brings forth but one young, in holes of 'trees, near the root; and at this period she is dan-'gerous even to men. The flesh of this animal is eaten 'by the common people of Cayenne; it is black, and 'has neither fat nor flavour. His skin is thick and hard; 'and his tongue is nearly of the same conical form with 'his muzzle.

'The great ant-eater,' continues M. de la Borde, 'acquires not his full growth in less than four years. 'His respiration is performed solely by the nostrils. 'At the first vertebra, which joins the neck to the head, 'the wind-pipe is very large; but it suddenly contracts, 'and forms a canal, which is continued in the horn or 'trunk that serves the animal for an upper jaw to the 'nostrils. This horn is a foot in length, being as long 'at least as the rest of the head. The wind-pipe has 'no opening into the mouth; and yet the aperture of 'the nostrils is so small as hardly to admit a common 'quill. The eyes are very small, and the animal sees at 'a side only. His fat is extremely white. When he 'crosses rivers, he carries his long tail on his back.'

Messrs. Aublet and Olivier assure me, that the great ant-eater feeds by means of his tongue only, which is covered with a viscid humour, to which the insects adhere. They add, that his flesh is not bad.

THE MIDDLE ANT-EATER.

The animal here represented, the skin of which is well preserved in the royal cabinet, belongs to the species of *tamandua* or middle ant-eater. It differs from the *tamanoir*, or great ant-eater, not only in size, but in figure. Its head is proportionally much thicker. The eye is so small that it exceeds not a line in breadth. The ears are round, and fringed above with large black hairs. The body, from the tip of the nose to the origin of the tail, is thirteen inches long and ten inches high. The hair on the top of the back is fifteen lines long, and that on the belly, which is of a dirty white colour, is of an equal length. The tail, which is only seven inches and a half long, is wholly covered with long yellow hair, and variegated with bands or rings slightly tinged with black.

In all this description there are only two characters which accord not with that given of the tamandua by Marcgrave. 1. The tail is all garnished with hair; but that of Marcgrave was naked at the extremity. 2. In our tamandua there are five toes on the fore feet; in

that of Marcgrave there were only four. But as they agree in every other article, we must conclude this animal to be a variety of the tamandua, or middle ant-eater, if not precisely the same species.

M. de la Borde seems to point out this animal under the name of the *little tamanoir.*

'It has,' says he, 'whitish hair, about two inches 'long, and weighs above sixty pounds. It has no teeth; 'but its claws are very long. Like the former, it feeds 'during the night, and the female brings forth but one 'at a time. Its manners are also the same, and it fre-'quents the large forests. Its flesh is very good; but 'it is more rarely to be met with than the great ta-'manoir.'

I wish M. de la Borde had given a more particular account of this animal, that all uncertainty with regard to its species might have been removed.

THE LEAST ANT-EATER.

With regard to this animal, M. de la Borde at the same time sent me the following remarks.

'It has bright reddish hair, and somewhat of a golden 'colour. It feeds upon ants, which adhere to its long 'worm shaped tongue. This animal is not larger than 'a squirrel. It moves slowly, and is easily taken. Like 'the sloth, it fixes itself to a staff; and as it has no 'desire to disengage itself, it may be carried in this 'manner wherever we please. It has no cry. We often 'find these animals adhering to branches by their claws. 'The females bring forth only one at a time in holes of 'trees, which they line with leaves. They feed in the 'night only. Their claws are very dangerous; and 'they clasp them so close that it is impossible to loose 'them. They are not rare; but it is difficult to per-'ceive them on the trees.'

M. Vosmaer has made a very erroneous criticism on what I have said concerning the least ant-eater.

'I must remark,' says he, 'though contrary to the 'opinion of M. de Buffon, that last year M. Tulbagh 'sent me an animal under the name of *porc de terre,* 'which is the *myrmecophagus* of Linnæus; so that 'Desmarchais and Kolbe were right in maintaining that 'this animal was found in Africa as well as in America. 'If we form a judgment from the specimen sent me, 'which is preserved in spirit of wine, appears to be 'new born, and is as large as a good pig, we must con-'clude the full grown animal to be of a considerable size. 'The following are its principal characters, as far as 'they could be remarked in an animal so young.

'The muzzle is pretty broad at the point, round, and 'somewhat compressed above. The ears are very broad, 'long, thin, pointed, and pendulous. On the fore feet 'there are four toes; the first and third are of equal 'length, the second somewhat longer, and the fourth or 'exterior one a little shorter than the third. The four 'claws are very long, a little hooked, sharp, and nearly 'of an equal size. On the hind feet there are five toes, 'the three intermediate ones being nearly equal in 'length, and the two exterior much shorter; the claws 'are smaller, and the two exterior ones are least. The 'tail, without being long, is thick, and terminates in a 'point. The two *myrmecophagi* of Seba are certainly 'the same, and differ only in colour, and the figures 'given of them are good. This is a particular species, 'totally different from the *tamandua-guacu* of Marc-'grave, or the *tamanoir* of M. de Buffon.'

From this passage it might be thought that I was deceived with regard to the animal represented by Seba. However, I have said precisely the same thing with M. Vosmaer; 'The animal called *tamandua, murmecophage* 'd'*Amerique,* by Seba, has no resemblance to any of the 'three, of which we are here treating.' Now, the three American animals which I mentioned were the great, middle, and least ant-eaters. What M. Vosmaer remarks, therefore, contradicts nothing I have advanced; which amounts to this, that these three animals are peculiar to America, and not to be found in the Old Continent. This language is so precise that M. Vosmaer can have nothing to oppose to it. If the *myrmecophagus* of Seba is found in Africa, it only proves that Seba was deceived when he calls it the American *myrmecophagus,* but can have no effect upon what I have advanced, and still persist in maintaining, that the three ant-eaters are found in America, and not in Africa.

THE SHORT TAILED AND THE LONG TAILED MANIS.

THE back, sides, and upper part of the tail of these animals, are covered with large strong scales. The mouth is small, and the tongue long. They have no teeth.

The short-tailed scaly lizard has the back, sides, and legs covered with blunt scales, and bristles between each. There are five toes on each foot, and the tail is not longer than the body. The ears are not unlike

the human. The chin, belly, and inside of the legs are hairy.

The long-tailed scaly lizard has a slender nose, which, with the head, is smooth. The body, legs, and tail, are guarded by long, sharp pointed, striated scales. The throat and belly are covered with hair. The legs are short. There are four claws on each foot, one of which is very small. The tail tapers a little, but ends blunt. The length, from nose to tail, is fourteen inches and a half, and that of the tail is three feet four inches and a half.

These animals are commonly known by the name of scaly lizards. We have rejected this denomination, 1. Because it is compounded; 2. Because it is ambiguous, and is applied to both species; 3. Because it is improper, these animals being not only of a different species, but of a different class from the lizards, which are oviparous reptiles; instead of which the animals under consideration are viviparous quadrupeds.

All lizards are entirely covered with a smooth skin, variegated with spots which resemble scales. But the short and long tailed manis have no scales on the throat, breast, and belly. The long-tailed manis, like other quadrupeds, has hair on all the inferior parts of the body; and the short-tailed manis has on these parts a smooth skin only without hair. The scales which cover the other parts of both these animals adhere not entirely to the skin, but are strongly fixed by their under part only. Like the quills of the porcupine, they are moveable, and are elevated or depressed according to the will of the animals. When irritated they erect their scales, and particularly when they roll themselves up like a ball. These scales are so large, hard, and poignant, that they repel every animal of prey. They form an armour which wounds as well as resists. The most cruel and famished creatures, as the tiger, panther, &c. endeavour in vain to devour these animals. They trample upon, and toss them about; but whenever they attempt to seize them, they receive very dangerous and painful wounds. No animal of prey is able to face, crush, or suffocate them, although it loads them with its whole weight. The fox is afraid of the hedgehog when rolled up; but he forces it to extend by trampling on it with his feet. As soon as the head appears he seizes it by the snout, and thus accomplishes his purpose. But of all animals, without excepting the porcupine, the armour of the manis is most offensive. When these animals contract their bodies, and present their armour, they brave the fury of all their enemies. Besides, when rolled up these animals assume not, like the hedgehog, a globular figure: their body in contracting takes the form of a clue; but their long thick tail remains without, and serves as a ring or belt to the body. This exterior part, by which it would appear the animals might be seized, defends itself; for it is furnished, both above and below, with scales as hard and sharp as those which cover the body; and as it is convex above and flat below, and has nearly the figure of a half pyramid, the angular sides are covered with sharp erected scales; so that the tail seems to be still more carefully defended than the body, the inferior parts of which are deprived of scales.

The short tailed manis is larger than the long tailed kind. His fore feet are covered with scales to their extremity; but the feet of the long tailed species, and even a part of the fore legs are covered with hair only. The scales of the former are larger, thicker, more convex, and less chamfered than those of the latter, which are armed with three sharp points, while those of the short tailed manis are not pointed, but uniformly sharp. The long tailed manis has hair on the inferior parts of the body; the short tailed kind has no hair under the body, but between the scales which cover the back there are some hairs as thick and long as hogs' bristles, which are wanting in the long tailed species. These are all the essential distinctions that we have observed by examining the stuffed skins of both these animals, which differ so much from all other quadrupeds, that they have been regarded as a kind of monsters. The differences we have pointed out, being general and constant, authorise us to conclude the short and long tailed manis to be distinct species. We recognised these relations and differences not only by inspecting three subjects, but likewise by perusing all the remarks of travellers and naturalists.

The short tailed manis when full grown is from six to eight feet long including the tail, which is nearly the length of the body, but appears to be proportionally shorter while the animal is young; the scales are also smaller and thinner, and of a paler colour; but in the adult animal their colour becomes deeper, and they acquire such a degree of hardness as to resist a musket ball. The long tailed manis, as formerly remarked, is much less than the short tailed species. Both of them have some relation to the great and middle ant-eaters; for they feed upon ants, have very long tongues, a narrow mouth without any apparent teeth, very long bodies and tails, feet and toes nearly of the same size and figure, though different in number, both species of manis having five toes to each foot, while the ant-eaters have only four on the fore feet. The latter are covered with hair, and the former with scales; neither are they natives of the same continent. The ant-eaters are found only in America, and the two species of manis in the East Indies and Africa, where they are called *quogelo* by the negroes, who eat the flesh of these animals, which they reckon delicate and wholesome, and use their scales for several purposes. In fine, these creatures have nothing disgusting about them but their figure. They are gentle and innocent, feeding only on insects. They run slowly, and cannot escape from a man but by concealing themselves in holes of rocks, or in those they dig in the

arth, where the females bring forth their young. They are two extraordinary species, not numerous, and very useless. The oddness of their form seems to be intended to constitute the last shade between the figure of quadrupeds and that of reptiles.

[We find in the woods a quadruped which the negroes call *quogelo*. From the neck to the extremity of the tail it is covered with sharp scales, resembling the leaves of the artichoke. They are close, and so thick and strong, as to defend it against the claws and teeth of the most rapacious animals. It is perpetually chased, and easily overtaken, by the tigers and leopards. But as its claws and mouth would be a feeble defence against the dreadful tusks and talons of these animals, nature has taught it to roll itself up like a ball by folding its tail under the belly, and contracting its body in such a manner as to present on all sides the sharp points of its scales. The tiger or leopard, when they turn the creature too rudely with their paws, receive such wounds as oblige them to retire. The negroes kill it with battons, sell the skin to the whites, and eat the flesh, which they say is white and delicate. Its tongue is enormously long, and covered with a viscid liquor. It goes in quest of ants nests and the haunts of insects; extends its tongue, which it either pushes into their holes or lays it flat upon the places where they pass. These insects, attracted by the odour, quickly run toward the tongue, remain entangled in the viscid liquor; and when the tongue is properly loaded with them, the animal retracts it, and devours them. This creature is not mischievous. He never attacks any person, but, provided he can find a sufficient quantity of ants, is perfectly contented. The largest of this species that has been observed is eight feet long, comprehending the tail, which is four feet.—*Voyage de Desmarchais.*]

THE ARMADILLO.

WHEN a quadruped is mentioned, the very name seems to convey the idea of an animal covered with hair. In the same manner, when we speak of a bird or a fish, feathers and scales present themselves to the imagination, and appear to be inseparable attributes of these beings. Nature, however, as if she intended to withdraw herself from all method, and to elude our most general views, contradicts our ideas and denominations, knows nothing of our arbitrary characters, and astonishes us still more by her exceptions than by her laws. Quadrupeds, which should be regarded as constituting the first class of animated nature, and are, next to man, the most conspicuous creatures in this world, are nevertheless neither superior in every respect, nor separated by permanent characters or attributes from all other beings. The first character, that of having four feet, and from which their name is derived, is found among the lizards, frogs, &c. which differ so much from quadrupeds in every other article, that they have with propriety been thrown into a distinct class. The second general property, that of being viviparous, belongs not exclusively to quadrupeds, but is common to them and the cetaceous animals. In fine, the third attribute, that of being covered with hair, which appears to be the least equivocal because it is the most conspicuous, exists not in several species which cannot be retrenched from the order of quadrupeds, since with the exception of this character alone their resemblance to each other is complete: and as these seeming exceptions of nature are in reality but the shades she employs to connect beings of the most remote kinds, we ought to seize these singular relations as often as they present themselves. The armadillos, instead of hair, are covered, like the turtles, the lobsters, &c. with a solid crust. The manis is armed with scales similar to those of fishes. The porcupine carries a kind of prickly feathers, without vanes, but having quills like those of birds. Thus in the class of quadrupeds alone, and in the most constant and apparent character of these animals, that of being covered with hair, nature varies, by making them approach the three very different classes of birds, fishes, and the crustaceous tribes. Hence we ought never to judge of the nature of beings by a single character; for it will always be imperfect and fallacious. Even two or three characters, though extremely general, are often insufficient; and as I have frequently remarked, it is only by the union of all the attributes and an enumeration of all the characters that a judgment can be formed concerning the permanent and essential qualities of the productions of nature. Accurate descriptions, without any attempt toward definitions, a more scrupulous examination of the differences than of the similarities, a particular attention to the exceptions, and even to the slightest shades, are the true guides, and I will venture to affirm, the only means we possess of investigating nature. If the time lost in framing definitions and methodical arrangements had been employed in making good descriptions, we should not at this day have found Natural History in her infancy, but should have had less difficulty in removing her swaddling clothes and her toys, and perhaps might have advanced her age; for

we should have written more for science and less against error.

But to return to our subject. Among viviparous quadrupeds, as we have seen, there are several species of animals which are not covered with hair. The armadillos alone constitute an entire genus, which includes a number of distinct species, and all of them are covered with a crust resembling bone. This crust covers the head, neck, back, flanks, rump, and extends to the extremity of the tail. The crust itself is also covered with a thin, smooth, transparent skin. The only parts to which this crust extends not, are the throat, the breast, and the belly, which are covered with a granulated skin, like that of a deplumed hen; and upon an accurate inspection of these parts, we discover in different places the rudiments of scales of the same substance with the crust. Hence the skin of these animals, even where it is most flexible, has a tendency to become osseous; but the ossification is completed in those places only where the skin is thickest, as on the superior and external parts of the body, and on the limbs. The crust consists not of one piece, like that of the turtle, but is divided into several bands connected to each other by membranes, which allow a certain degree of movement to this coat of mail. The number of these bands depends not, as has been imagined, on the age of the animal. The new born and the adult armadillo have the same number of bands, as appears by comparing the young with the old; and though we cannot be certain that those which have more or fewer bands never intermix or produce, it is at least very probable, since the difference in the number of moveable bands is constant, that they are either distinct species or permanent varieties, occasioned by the influence of different climates. In this uncertainty, which time alone can remove, we have chosen to treat of all the armadillos under one article, enumerating at the same time each kind as if it were a particular species.

Le Pere d'Abbeville appears to have first distinguished the armadillos by different names, which have been adopted by most subsequent authors. He has pointed out pretty clearly six species: 1. The twelve-banded armadillo, or *kabassou*. 2. The eight-banded, or *tatouete*. 3. The six-banded, or *encuberto* of Marcgrave. 4. The three banded, or *tatu-apara*. 5. The eighteen-banded, or *cirquincon*. 6. The nine-banded, or *cachichame*. The different species have been confounded by other travellers. But we have occasion to borrow the descriptions of two kinds only, having seen the other four.

All the armadillos, except the eighteen-banded, have two bony shields, one on the shoulders another on the rump. Each of these consists of one solid piece. But the cuirass, which is likewise osseous, and covers the body, is divided transversely into more or fewer moveable bands, connected by a flexible skin. But the armadillo with eighteen bands has one shield only, which is upon his shoulders. The rump, instead of a shield, is covered with moveable bands, similar to those above mentioned. We shall now describe each species particularly, according to the number of bands.

THE THREE BANDED ARMADILLO.

It has short but broad rounded ears. The crust on the head, back, and rump, is divided into elegant pentangular, tuberculated segments. There are three bands in the middle, five toes on each foot, and the tail is short.

Clusius is the first author who described this animal; and though his description was taken from a drawing only, it is easy to perceive, from the remarkable characters of having three moveable bands on the back, and a short tail, that it is the same species of which Marcgrave has given a good description under the name of *tatu apara*. The head is oblong, and almost pyramidal; the eyes are small, the ears short and rounded, and the top of the head is covered with a helmet consisting of one piece. On all the feet there are five toes. The two middle claws of the fore feet are very large, the two lateral ones smaller, and the fifth, or exterior one is the least. The claws of the hind feet are shorter and more equal. The tail exceeds not two inches in length, and is wholly covered with a shell or crust. The body is a foot long, and about eight inches over at the broadest part. The back or cuirass is divided into four joints, and composed of three transverse moveable bands, by which the animal is enabled to bend its body and to roll itself up like a ball. The skin which forms the joints is very flexible. The shields which cover the shoulders and rump consist of pentangular pieces very equally ranged. The three moveable bands between the two shields are composed of square or oblong pieces, and on each piece there is a number of lenticular scales of a yellowish white colour. Marcgrave adds, that when the creature lies down to sleep, or when touched by any person, he gathers his feet together, puts his head below his belly, and makes the whole body so perfectly round, that he has more the appearance of a sea-shell than of a land animal. This contraction is effected by means of two large muscles on the sides of the body; and it is with difficulty that the strongest man can force an extension with his hands. Piso and Ray have added nothing to Marcgrave's description. But it is singular that Seba, who has given us a figure and description nearly the same with those of Marcgrave, should not only not mention this author, but assert with confidence, 'that this 'animal is unknown to the naturalists; that it is ex-'tremely rare; that it is found in the most remote 'countries of the East Indies,' &c. whilst, in fact, this Brasilian armadillo is excellently described by Marc-

grave, and the species as common as any other, not indeed in the East Indies, but in America, where it is very frequent. The only real difference between the description of Seba and that of Marcgrave is, that the latter gives the animal five toes to each foot, and the former only four. One of them must be wrong; for they both evidently describe the same animal.

Fabius Columna has described and given figures of the dried crust of an armadillo, contracted in the form of a ball, which appears to have had four moveable bands. But as this author was totally ignorant of the animal whose skin or shell he describes; as he knew not the very name of the armadillo, though mentioned by Belon more than fifty years before, but gave it the compound appellation of *cheloniscus;* besides, as he acknowledges that the crust he describes had been pasted together, and that some pieces were wanting, we have no proper authority to pronounce, as our modern nomenclators have done, that an armadillo with four moveable bands has an existence in nature, especially as no notices have been communicated by any other naturalist concerning this animal, since the imperfect and suspicious account given by Fabius Columna in the year 1606. If it did exist, it would certainly have found its way into some of our cabinets, or been observed by travellers.

THE SIX-BANDED ARMADILLO.

The crust of the head, shoulders, and rump, is formed of angular pieces. It has six bands on the back, between which, and also on the neck and belly, are a few scattered hairs. The tail is not the length of the body, very thick at the base, and tapers to a point. There are five toes on each foot.

This armadillo is larger than the former. The top of the head, the neck, body, limbs, and tail, are covered with a very hard osseous crust, composed of pretty large pieces most elegantly placed. Each of the two shields on the shoulders and rump consist of one piece. There is indeed beyond the shield on the shoulder, and near the head, a moveable band which enables the animal to bend his neck. The shield on the shoulder consists of five parallel rows, which are composed of pieces that have five or six angles, with a kind of oval figure in each. The cuirass on the back, or the part between the two shields, is divided into six bands, connected to each other and to the shields by seven junctures of a thick flexible skin. These bands consist of large square or oblong pieces. On the skin of the joints there are several whitish hairs similar to those on the throat, breast, and belly. All the inferior parts of the body, instead of a hard crust, are covered with a granulated skin. The shield on the rump has a fringed border, the mosaic work of which resembles that of the moveable bands; the rest is composed of pieces very similar to those of the shield on the shoulders. The crust of the head is long, broad, and consists of one piece, as far as the moveable band on the neck. The muzzle is sharp, the eyes small and sunk, and the tongue narrow and pointed. The ears, which are naked, having neither hair nor crust, are short and brown, like the skin of the dorsal junctures. There are eighteen teeth in each jaw, and five toes on each foot, with pretty long, rounded, and rather narrow than broad claws. The head and muzzle nearly resemble those of a pig. The tail is thick at its origin, and gradually tapers toward the point, where it is very thin, and rounded. The colour of the body is a reddish yellow. The animal is commonly plump and fat; and the penis of the male is very conspicuous. He digs the earth with great ease by the assistance of his snout and claws. He lives in his burrow during the day, and comes out in the night only to search for food. He drinks often, and feeds upon fruits, roots, insects, and birds, when he can seize them.

THE EIGHT-BANDED ARMADILLO.

This armadillo has upright ears two inches long, small black eyes, eight bands on the sides, four toes on the fore feet, and five on the hind. The length from nose to tail is about ten inches, and that of the tail nine.

This armadillo is not so long as the six-banded species. The head is small, the muzzle sharp, the ears erect and pretty long, and the tail is proportionably longer, and the limbs shorter than those of the six-banded armadillo. The eyes are small and black; there are four toes on the fore, and five on the hind feet; the head is covered with a helmet, the shoulders and rump with two shields, and the body with a cuirass composed of eight moveable bands connected to each other and to the two shields by nine junctures of flexible skin. The tail is likewise covered with eight moveable rings of crust, and nine joints of flexible skin. The colour of the cuirass on the back is an iron gray, and the flanks and tail are of a whitish gray mixed with spots of iron gray. The belly is covered with a whitish granulated skin, interspersed with some hairs. The head of the individual described by Marcgrave was three inches long, the ears nearly two, the legs about three, the two middle toes of the fore feet one inch, and the claws half an inch. The length of the body from the neck to the origin of the tail was seven inches and that of the tail nine. The crust of the shields was interspersed with prominent white spots of the size of lentils. The moveable bands were marked with triangular figures. This crust is not very hard for the smallest shot pierces it and kills the animal, whose flesh is white and extremely delicate.

THE NINE-BANDED ARMADILLO.

This species has long ears. The crust on the shoulders and rump are marked with hexangular figures. There are nine bands on the sides, distinguished by transverse cuneiform marks. The breast and belly are covered with long hairs. There are four toes on the fore feet, and five on the hind. The tail is long and taper. The length of the whole animal is three feet.

Nieremberg's description of this animal is extremely imperfect; those of Wormius and Grew are much better. Wormius's individual was an adult, and one of the largest of the species; that of Grew was younger and smaller. We shall only give their descriptions as far as they correspond with our own specimen. Besides, it is probable that the nine-banded armadillo is not a distinct species from the eight-banded; for in every other respect they seem to have a perfect resemblance to each other. We have two eight-banded armadillos which are dried, and appear to be males; and we have seven or eight with nine bands; one of them, which is entire, is a female, the others are so disfigured in drying that the sex is not distinguishable. It would appear, therefore, that the eight-banded is the male, and the nine-banded the female. This is only a conjecture, which I mention here, because in the following article we shall see two armadillos, one of which has more rows on the rump-shield than the other, and yet their resemblance is so great that this difference may depend solely on sex; for it is not improbable, that a greater number of rows and of moveable bands may be necessary for facilitating the gestation and delivery of the females.

In the individual described by Wormius the head was five inches long, from the end of the muzzle to the ears, and eighteen inches from the ears to the origin of the tail, which last was a foot in length, and composed of twelve rings. In an individual of the same species described by Grew the head was three inches, the body seven and a half, and the tail eleven. The proportions of the head and body correspond very well; but the difference in the tail is too considerable; and it is probable, that in Wormius's individual the tail had been broken, for it ought to have exceeded a foot in length. As in this species the tail tapers to a point as small as an awl, and is at the same time very brittle, it is rare to preserve a specimen with the tail entire as in that described by Grew.

THE TWELVE-BANDED ARMADILLO.

This armadillo has broad upright ears. The crust on the shoulders is marked with oblong pieces, and that of the rump with hexangular ones. It has twelve bands on the sides, five toes with very large claws on the fore feet, and five lesser on the hind. The tail is shorter than the body, and there are some scattered hairs on the body.

This animal seems to be the largest of the armadillo kind. Its head is thicker and broader, and its muzzle not so slender as those of the other species. The legs and feet are also thicker, and the tail has no crust, a peculiarity which sufficiently distinguishes it from all the others. It has five toes on all the feet, and twelve distinct moveable bands. The shield on the shoulders consists of four or five rows only, each of which is composed of pretty large quadrangular pieces. The moveable bands are likewise composed of large and almost square pieces. Those which compose the rump shield are nearly similar to those on the shoulders. The helmet on the head consists of large irregular pieces. Between the joints of the moveable bands, and in other parts of the armour, there are some hairs, like hogs' bristles. Upon the breast, belly, legs, and tail, we perceive the rudiments of scales, which are round, hard, and polished, like the rest of the crust, and round these are small tufts of hair. The pieces which compose the helmet, the two shields, and the cuirass, being proportionably larger and fewer in number in the twelve-banded than in the other armadillos, entitle us to conclude that it is the largest of the kind. In that represented in the figure the head was seven inches long, and the body twenty-one. But we are uncertain whether that represented in the former plate belongs to the same species. They are similar in many respects, particularly in having twelve moveable bands. But they likewise differ in so many articles that it is perhaps rash to ascribe these differences to sex alone.

THE EIGHTEEN-BANDED ARMADILLO.

This species has a very slender head and small erect ears. The crust on the shoulders and rump consists of square pieces. There are five toes on each foot. The length from nose to tail is about fifteen inches, and that of the tail five and a half.

Mr. Grew first described this animal from a skin preserved in the cabinet of the Royal Society. All the other armadillos have two shields, one on the shoulders and another on the rump. But the eighteen banded species has only one shield, which is upon the shoulders. It has obtained the name of the *weasel armadillo* because its head resembles that of the weasel. From Grew's description of this animal we find that the body was about ten inches long, the head three, and the tail five The legs were from two to three inches in length; the forehead was large and flat; the eyes were small, and the ears an inch long. It had five toes on each foot, and large claws of an inch long on the three middle toes, the others being smaller. The armour of the head and that of the legs were composed of round scales, about a quarter of an inch in diameter. The armour of the neck consisted of one piece formed of small square

scales. The shield on the shoulders consisted also of one piece, composed of several rows of similar small square scales. These rows on the shield, in this as well as in all the other species, are continuous, and adhere by a symphysis. The rest of the body, from the the shield on the shoulders to the tail, is covered with moveable bands separated from each other by a flexible skin. These bands are eighteen in number. The anterior ones are largest, and composed of small square and oblong pieces. The posterior consist of round and square pieces; and the extremity of the armour, near the tail, is of a parabolic figure. The first half of the tail is covered with six rings, composed of small square pieces; and the second half, as far as the point, is covered with irregular scales. The breast, the belly, and the ears, are naked, as in the other species. Of all the armadillos, from the moveable bands which extend to the tail, it should appear that this species has the power of contracting and rolling itself up like a ball with the greatest ease.

We have taken this description, as well as Mr. Ray, from Grew. M. Brisson has also followed Mr. Ray, and given a good description of this animal, which he calls simply the *armadillo*. But it is singular, that Linnæus, though he had the descriptions of Grew and Ray before his eyes, should mention this animal as having but one band, when it has no less than eighteen. This notion proceeds from a blunder as evident as that of mistaking the *tatu, seu armadillo Africanus* of Seba for the *tatu mustelinus* of Grew, which, even from the description of these authors, are very different animals. It is equally certain, that the animal described by Grew is a real existing species, as the existence of that of Seba, at least as he describes it, is doubtful. In his estimation this African armadillo has the whole armour of its body divided into three parts. If this were true, instead of many bands the back and sides would be covered with one piece bounded by the shields on the shoulders and rump. This passage is the foundation of Linnæus's error, who calls the animal *dasypus unicinctus, tegmine tripartito.*

All the armadillos are natives of America. Before the discovery of the New World they were totally unknown. They are never mentioned by the ancients; modern travellers uniformly speak of them as animals peculiar to Mexico, Brasil, Guiana, &c. and no person ever pretends to have seen any of the species either in Asia or Africa. Some voyagers have indeed confounded the armadillos of America with the manis or scaly lizard of the East Indies. Others have imagined that they existed on the west coasts of Africa, because they have sometimes been transported from Brasil to Guinea. Belon, who wrote more than two centuries ago, and is the first who gave a description and figure of an armadillo from a skin he had seen in Turkey, tells us, that it came from the New Continent.

[With regard to the animal I formerly mentioned under the name of *tatou*, it is always brought from Guinea and the New World; and though it is not taken notice of by the ancients, I have given a figure of it.

Nature has armed this creature with a hard crust and large scales, like a corselet, by which means the inwards and flesh are easily taken out, without injuring its natural figure. From these circumstances it may be carried to any distance, and accordingly it is not uncommon in our cabinets. It may be called the Brasilian hedgehog; for it retires into its scales as a hedgehog does into his bristles. It exceeds not the size of a middling pig. It is indeed a species of hog, having the same legs, feet, and muzzle. It has been seen alive in France, and it feeds upon grain and fruits.—*Observ. de Belon.*]

Oviedo, de Lery, Gomara, Thevet, Antoine Herrara, P. d'Abbeville, Frangois Ximenes, Stadenius, Monard, Joseph Acosta, de Laet, and all the modern historians, mention these animals as natives of South America. Of all the writers I have quoted, Piso alone has advanced, but without any authority, that the armadillos are found in the East Indies, as well as in America. He has probably confounded the scaly lizards with the armadillos. The former are called armadillos by the Spaniards. This error has been adopted by our nomenclators and describers of cabinets, who have not only admitted the armadillos into the East Indies, but into Africa, though none of them ever existed in those parts of the world except such as were transported from America.

The climate and country of these animals, therefore, are not equivocal: but it is more difficult to determine the size of each kind. With this view we have compared the skins of a great number preserved in the royal and other cabinets: we have also compared all the descriptions of authors with our own, without being able to draw any certain conclusion. It only appears that the twelve and six-banded armadillos are the largest, and that the three, eight, nine, and eighteen-banded species are the least. The head of the larger kinds is more solid and harder than that of the smaller; the pieces of which it is composed are larger and fewer in number; the moveable bands encroach less upon each other; and the skin and flesh are harder, and not so good. Piso says, that the flesh of the six-banded armadillo is not eatable; and Nieremberg assures us, that it is noxious. Barrere tells us, that the twelve banded armadillo has a strong odour of musk. All authors agree, that the flesh of the three-banded, and particularly that of the eight-banded species, is as good as that of a pig. They likewise remark, that all the small kinds frequent the plains and marshes; and that the largest species are found in dry and elevated places only.

All these animals have the faculty of contracting their bodies in the form of a ball with more or less facility.

When contracted the defect of their armour is most conspicuous in those which have fewest moveable bands. In this situation the three-banded species presents two large voids between the shields and the armour of the back. None of them can assume a form so perfectly round as the hedgehog; they have rather the figure of a globe very much flattened at the poles.

The singular crust with which they are covered is a real bone composed of small contiguous pieces, which, without being moveable or articulated, except at the joints of the bands, are united by a symphysis, and may all be separated from each other when heated in a fire. When the animal is alive, these small pieces, both in the shields and moveable bands, obey in some measure its motions, especially that by which it contracts itself. If this were not the case, it would possibly roll itself up. These pieces are of different figures in different species, and are always arranged with as much regularity as the most elegant mosaic work. The thin pellicle which covers the crust is a transparent skin, which has the effect of a varnish to the whole body. This skin rises a good deal, and even changes the reliefs of the mosaic work, which are very different when it is removed. Besides, this osseous crust is only a cover, totally independent of the internal parts of the animal's body, whose bones and other organs are constructed like those of all other quadrupeds.

[The nine-banded armadillo is very sensible. When his scales are pressed he complains, and rolls himself up like a ball. I remarked that all the rows, beside the movement by which they joint into each other, have another along the spine of the back, which enables them to extend and enlarge themselves, &c.—*Nouv. Voy. aux Isles de l'Amerique.*]

The armadillos in general are inoffensive animals, and do no mischief unless they are allowed to enter the gardens, where they eat melons, potatoes, and other roots and pot-herbs. Though natives of the warm climates of America, they can live in temperate regions. Some years ago I saw one in Languedoc, which was fed in the house and went about freely without doing any harm. They walk quickly; but they can neither run, nor leap, nor climb trees, so that they can never escape those who pursue them. Their only resources are to conceal themselves in their holes, or if too distant from their retreats to endeavour to dig a hole before they are seized; for the mole digs not more quickly than the armadillo. Before being totally concealed they are are sometimes caught by the tail, when they make such a powerful resistance that the tail is left in the hands of the enemy. To prevent mutilating them in this manner it is necessary to widen the holes, and then they are taken without resistance. Whenever they are seized they roll themselves up, and never extend till they are placed near a fire.

[The nine-banded armadillos, when their head and part of the body are concealed in the hole, believe themselves to be safe; and indeed they have nothing to fear, unless the following expedient be used to drag them out. The Indian arrives, and seizes the animal by the tail, which is very long. The armadillo opens his scales, and attaches them so strongly to the walls of his hole, that the Indian may pull off the tail, but cannot force the animal from his retreat. In this case the hunter tickles him with a stick or the end of his bow, which makes the animal contract his scales, and then he is taken without difficulty.—*Hist. Nat. de l'Orenoque, par Gumilla.*]

Their crust, though hard and rigid, is so sensible, that when touched by the finger the animal feels the impression, and instantly contracts itself. When their holes are deep they are forced out by smoke or by water. They are said to remain in their holes during a third part of the year. It is certain, however, that they never come out but during the night, when they go in quest of food. The armadillo is hunted with small dogs, by whom they are soon overtaken. They contract themselves long before the dogs come up with them; and in this state they are seized and carried off. When on the top of a precipice they escape both the dogs and the hunter; for they contract, and allow themselves to roll down like a bullet, without breaking their crust or receiving any injury.

These animals are fat, and very fruitful. The male exhibits, by his internal organs, great generative powers. The female is said to produce every four months; and, accordingly, the species is very numerous. As they make excellent eating, they are hunted in every manner. They are easily taken with snares that are laid on the edges of waters and other moist places, which they always frequent. They never remove far from their holes, which are very deep, and which they endeavour to regain upon every alarm. They are said not to be afraid of the bite of the rattle-snake, though it is as dangerous as that of the viper. It is said that they live in peace with these reptiles, which are often found in their holes. The savages employ the crust of the armadillo for several purposes. They paint it with different colours, and make of it baskets, boxes, and other small vessels. Monard, Ximenes, and other writers, ascribe great medicinal powers to different parts of these animals. They assure us, that the crust reduced to a powder, and taken internally, even in a small dose, is a powerful sudorific; that the hip-bone pulverised cures the venereal disease; that the first bone of the tail, applied to the ear, restores hearing to the deaf, &c. We can give no credit to these extraordinary powers. The crust and bones of the armadillo are of the same nature with the bones of other animals. Effects so marvellous can only be produced by imaginary virtues.

SUPPLEMENT.

Our original figure of the six-banded armadillo was taken from a preserved crust. The figure now represented was drawn from the life by M. de Seve, who at the same time sent me the following description.

'The male is fourteen inches long, without reckoning 'the tail, and corresponds pretty well with the description given in your work. However, in your description 'it is said the shoulder-shield consists of five parallel 'rows of small pentangular pieces, with an oval in each. 'But these characters seem to vary; for in the animal 'I have drawn the shoulder-shield is composed of six 'parallel rows, of which the small pieces are irregular 'hexagons. The rump-shield consists of ten parallel 'rows, and the small pieces are narrow squares. The 'rows near the tail lose their square form, and become 'more round. The tail, a part of which was broken off, 'is four inches and a half in length; but in the drawing I have made it six inches. In walking it carries 'the tail high, and a little crooked. The trunk is covered with an osseous crust as well as the body. The 'trunk has six unequal rows, composed of small irregular hexagons. The head is three inches ten lines 'long, and the ears one inch three lines. The eye, 'instead of being sunk, as remarked in your history, is 'indeed very small, but the globe is prominent, and 'well defended by eye-lids. The body is very fa and 'the skin of the belly is wrinkled, and full of small 'tubercles, from which issue a number of pretty long 'white hairs. The crust on the broadest part of the 'body, is six inches seven lines. The fore legs are two 'inches two lines long, and those behind three inches 'four lines. The fore claws are very long, the longest 'being one inch three lines, the next one inch two 'lines, and the smallest ten lines. The length of the 'hind legs is at most half an inch. The legs are covered 'as far as the claws with a yellowish scaly skin. When 'the animal walks he supports himself on the tips of the 'claws of the fore feet. His penis, when drawn out in 'a state of repose is six inches seven lines long, near 'four lines thick, and must augment considerably during its erection. When the penis stretches it lies upon 'the belly like a snail, leaving a space of a line or two 'between each circumvolution. I have been told, that 'when these animals copulate the female lies on her 'back to receive the male. The one I have described 'was only eighteen months old.'

M. de la Borde remarks, that there are two species of armadillos in Guiana. The largest is black, and weighs from eighteen to twenty pounds. The other, which is brown, or rather iron-coloured, has three claws of different lengths. Its tail is soft, and without any armour, being covered with a simple skin. It is much smaller than the other, and weighs about three pounds only.

'The large armadillos,' says M. de la Borde, 'bring 'forth eight, and sometimes ten at a litter, in their 'holes, which they dig very deep. When attempts are 'made to unkennel this animal he labours hard to render 'the hole still deeper, and descends almost perpendicularly. He goes out in the night only, and feeds upon 'worms, woodlice, and ants. His flesh is good, and in flavour somewhat resembles that of a pig. The small iron-'coloured armadillo brings forth only four or five young; 'but she digs still deeper, and is more difficult to catch. 'When it rains, these animals go out during the day; 'but in fair weather they remain in their holes till night. 'They are always solitary; and they are known to be in 'their holes by a number of flies which follow their 'scent. When the hunter digs in order to seize them, 'they dike likewise; and by throwing the earth behind, 'shut up the mouths of their holes so completely that 'no smoke can enter. The females bring forth in the 'beginning of the rainy season.'

The large black armadillo of M. de la Borde may be referred to the twelve-banded species, which is the largest of all the armadillos; and the small iron-coloured kind may be referred to the eight-banded armadillo, though M. de la Borde says, that its tail is naked, a fact which merits confirmation.

We have given a figure of an armadillo with nine moveable bands and a very long tail. Dr. William Watson has described this armadillo, of which the following is an extract. This animal was living in the house of Lord Southwell, and was brought from America. The figure, however, in the Philosophical Transactions was not drawn till after the animal's death, which is the reason why it is rough and hard, as it is in our figure. This animal weighed seven pounds, and exceeded not the size of an ordinary cat. It was a male, and grew considerably while in Lord Southwell's possession. It was fed with flesh and milk, and refused to eat grain or fruits. Those who brought it from America assured us, that it dug a lodging for itself in the earth.

THE PACA, OR SPOTTED CAVY.

THE upper jaw is longer than the lower. The nostrils are large, the whiskers long, the ears short and naked. The hairs are short and hard; the colour of the upper part of the body is a dark brown; the sides are marked lengthwise with lines of gray spots. The belly is white; in some, perhaps young ones, the sides and spots are of a pale yellow. There are five toes on each foot. It has only the mere rudiment of a tail. The length of the body is about ten inches. It is made like a pig, and in some places is called the hog-rabbit.

The paca, or spotted cavy is an animal peculiar to the New World. It digs holes in the earth, like the rabbit, to which it has often been compared, though there is very little resemblance between them. It is even larger than the hare. Its body is thicker and plumper; the head is round and the muzzle short. It is very fat, and rather resembles a young pig in figure, grunting, gait, and manner of eating; for it uses not, like the rabbit, its fore feet in carrying food to its mouth; and like the hog, it digs the earth in quest of nourishment. It frequents the banks of rivers, and is only found in the warm and moist places of South America. Its flesh is fat, and makes excellent food. Even its skin is eat, like that of a pig. For these reasons this animal is in perpetual request. It is difficult for the hunters to take him alive. When surprised in his hole, which they lay open both before and behind, he defends himself, and even bites in a cruel manner. His skin, though covered with coarse short hair, makes a very good fur, because it is regularly spotted on the sides. These animals produce often, and in great numbers; many of them are destroyed by men and beasts of prey; and yet the species is always numerous. It is a native of South America, and is found in no part of the Old Continent.

SUPPLEMENT.

The description of the spotted cavy, given in the last article, was taken from a young subject which had not acquired one half of its growth. I have since had one sent me, which, when it arrived, was larger than the former, and from the month of August 1774 to the 28th day of May 1775, during which period it was nourished in my house, its size continued to augment. I now proceed to give an account of its mode of living and acting, from the remarks of the Sieur Trécourt.

When provided with a wooden cage or box, this animal remains perfectly tranquil during the day, especially when plentifully supplied with food. He seems even to have an affection for his retreat, as long as the day lasts; for after feeding he retires spontaneously into it. But when night approaches, by perpetual restlessness and agitation, and by tearing the bars of his prison with his teeth, he discovers a violent desire to get out. Nothing of this kind happens during the day, unless he has occasion for some natural evacuation; for he cannot endure the smallest degree of dirtiness in his little apartment; and when about to void his excrements, he always retires to the most distant corner he can find. When his straw begins to smell he often throws it out, as if he meant to demand fresh litter. This old straw he pushes out with his muzzle, and goes in quest of rags or paper to replace it. But his attachment was not confined to his cage. All obscure corners seemed to be agreeable to him; and he often formed a new nest for himself in presses which he found open, or under the kitchen grate. Wherever he established a new abode, nothing but force could make him leave it. In this animal, which was a female, the propensity to cleanliness was so strong, that a large male rabbit being shut up with her when she was in season, she took an aversion to him the moment he voided his excrement in their common apartment. Before this event she received him so cordially that something was expected; she even made considerable advances, for she licked his nose, ears, and body; and she allowed him to take almost the whole food which was given her. But as soon as the rabbit had infected the cage with his ordure, she retired into the bottom of an old press, where she made a bed of paper and rags, and returned not to her old lodging till she saw it neat, and freed from the unclean guest which had been presented to her.

The spotted cavy is easily accustomed to a domestic life. Unless industriously irritated he is gentle and tractable. He is fond of adulation, and licks the hands of the person who caresses him. He knows those who take care of him, and readily distinguishes their voices. When gently stroked on the back, he stretches himself out, lies down on his belly, and by a small cry expresses his acknowledgment, and seems to ask a continuance of the favour. When seized in a rough manner, however, he makes violent efforts to escape.

His muscles are large and strong; and yet his skin is so sensible that the slightest touch is sufficient to excite in him the most lively emotions. This great sensibility, though generally accompanied with sweetness of temper, produces sometimes, when too much irritated, or when a disagreeable object is presented, the most violent paroxysms of passion. The bare sight of an unknown dog is sufficient to produce this effect in the spotted cavy. When confined in his cage, he has been observed, upon the entrance of a strange dog into the chamber, to

bite the door, and make an effort to force it. At first it was believed that he never wished to go out, unless when pressed by natural necessities. But when at full liberty we were surprised to see him dart out suddenly upon an innocent dog, which he bit very severely. In a few days, however, he became familiar with this dog. People with whom he is unacquainted, if they irritate him, he treats in the same manner. But he never bites those who have the care of him. He has an aversion to children, whom he always pursues. His passion is expressed by chattering his teeth, and is always preceded by a kind of grunting.

This animal sits often on his posteriors, and sometimes remains long in this situation. He has the air of combing his head and whiskers with his paws, which he continually licks and moistens with his saliva. In this operation he often uses both paws at a time; he then scratches all the parts of his body which he can reach with his fore feet, and completes his dressing by scratching with his hind paws such parts as cannot be reached by the fore ones.

This animal, notwithstanding, is gross and corpulent. His body is neither delicate, nor smooth, nor nimble, but rather heavy and lurid, having nearly the gait of a small hog. He runs seldom, and when he does, it is always with a bad grace. He has no vivacious movement but that of leaping upon the furniture, or upon such things as he wishes to seize and carry off. He resembles the hog still farther in the whiteness and thickness of his skin, which cannot be drawn off because it adheres to the flesh.

Though our animal had not acquired his full growth, he was eighteen inches long in his natural contracted situation; but when he extended himself he was near two feet from the point of the muzzle to the extremity of the body; while the spotted cavy described in the original work exceeded not seven inches five lines; which difference, as there was no other between the two animals, must be ascribed entirely to that of their ages.

The height before, in the individual we are now describing, is seven inches, and behind about nine inches and a half; so that in walking the hind part of the body appeared always higher than the head. The posterior part of the body is also the thickest, being nineteen inches and a half in circumference, while that of the anterior part is only fourteen inches.

The body is covered with short, coarse, thinly scattered hairs, of a dusky colour, and deeper on the back. But the belly, the breast, the throat, and the interior parts of the legs, are of a dirty white: this animal is rendered exceedingly remarkable by five longitudinal rows of white spots, which run along the body and approach each other at their extremities.

The head, from the nose to the top of the front, is near five inches long, and very convex. The eyes are large, prominent, of a brownish colour, and about two inches distant from one another. The ears are roundish, about eight lines in length, and nearly of an equal breadth at the base; they are plaited, and covered with a down so fine as to be almost imperceptible either to the touch or the sight. The end of the nose is broad, nearly of a black colour, and divided like that of the hare. The nostrils are very large. The animal has considerable strength and address in the management of this organ; for I have often seen him raise the portcullis of his cage with it. The under jaw is an inch shorter, and much narrower than the upper. On each side, and toward the base of the upper jaw, there is a kind of longitudinal fold, garnished with hair on the middle, which at first sight, especially when viewed sidewise, may be mistaken for the mouth; for the mouth appears not unless when it is open; its aperture exceeds not six or seven lines; and it is not above two or three lines distant from the fold mentioned above.

Each jaw is armed with two very long incisive teeth, which are as yellow as saffron, and of strength sufficient to cut wood. I have seen this animal, in the course of a single night, cut a hole in one of the planks of his lodging large enough to let out his head. His tongue is narrow, thick, and somewhat rough. His whiskers consist of black and white hairs, placed on each side of the nose; and there are similar hairs, but blacker and fewer in number, on each side of the head under the ears. The resistance of the animal prevented us from counting the number of its grinders.

Each foot, both before and behind, has five toes, four of which are armed with claws about half an inch long and of a flesh colour. But this colour should not be regarded as a constant character; for in several animals, and particularly the hare, we often find the claws black, while in other individuals they are whitish or flesh-coloured. The fifth or interior claw is very short, and visible only when the animal raises his foot. Between the hind feet, at a little distance from the organs of generation, there are two paps of a brownish colour. In fine, though the tail is hardly visible, by searching we find a small button of two or three lines long.

The domestic paca, or spotted cavy, eats every thing presented to him, and has a strong appetite. He is commonly fed with bread, which he eats equally well whether it be soaked in water, in wine, or even in vinegar. But he is so fond of sugar and fruits, that when offered to him he expresses his joy by bounding and leaping. He is also fond of roots and pot-herbs of all kinds; for he eats with equal relish grapes, cellery, onions, and garlic; and he refuses not coleworts, grass, moss, or the bark of trees. We have even seen him eat wood, though half charred. Flesh he seemed to like worse than any other food, and he eat it but rarely, and

in very small quantities. He might be easily fed with grain; for he often searched for it among his litter. When he drinks, he laps like the dog. His urine is thick, and has an insupportable odour. His excrements consist of small crottels, which are longer than those of the rabbit or hare.

From these minute observations we are led to believe that this species might be naturalized in France, which, as the animal is easily tamed, and his flesh is excellent, would be a useful acquisition. He seems not to be much afraid of cold; and, besides, as he can dig holes in the earth, he could easily defend himself against the rigour of winter. A single individual of this species would furnish as much good meat as seven or eight rabbits.

M. de la Borde informs us, that the spotted cavy generally lives on the banks of rivers; and that he forms his hole in such a manner as to have three different ways of entering or going out. 'When pursued,' M. de la Borde remarks, 'he takes to the water, and dives 'frequently; but when attacked by the dogs he makes 'a vigorous defence.' M. de la Borde adds, 'that the 'flesh of this animal is much esteemed at Cayenne, and 'that, however prepared, it is excellent.

'The spotted cavy lives alone in his hole, and leaves 'it not till night, when he goes in quest of food. He 'comes not abroad during the day, unless when he is 'obliged by the necessities of nature; for no dung is 'ever found in his kennel; and when he returns, he 'always shuts up the entrances with leaves and twigs. 'The female generally produces but one at a time, 'which quits not the mother till it be full grown, or, if 'it be a male, till it copulates. At Cayenne there are 'two or three species, which are said not to intermix. 'Some of them weigh from fourteen to twenty pounds, 'and others from twenty-five to thirty.'

THE VIRGINIAN OPOSSUM.

ALL the species of the opossum have two canine teeth in each jaw. The cutting teeth in each jaw are unequal. They have five toes on each foot; and the hind feet are formed like a hand, with a distinct thumb. The Virginian opossum has a long sharp pointed nose, large, round, naked, and very thin ears, small, black, lively eyes, and long stiff hairs on each side of the nose, and behind the eyes. The face is covered with short soft hairs of a dusky colour. Above each eye there is a large white spot. The cheeks are whitish, and the sides of the neck of a dirty yellow. The hind part of the neck, and the back, are covered with soft but uneven hairs, above two inches long, the bottoms of which are of a yellowish white, the middle part black, and the ends whitish. The sides are covered with dirty and dusky hairs, and the belly with soft, woolly, dirty white hair. The legs and thighs are black, the feet dusky, and the claws white. The base of the tail, for near three inches, is clothed with long hairs like those on the back, and the remainder with small scales; the half next the body is black, and the rest white. The tail has a disagreeable appearance, resembling the body of a snake, and has the same prehensile power as that of some monkeys. The body is round, and pretty thick, and the legs are short. The female, on the lower part of the belly, has a large pouch, in which the teats are lodged, and where the young shelter as soon as they are born. The length of one I examined was seventeen inches, and that of the tail fourteen.

The opossum is an American animal, and easily distinguishable from all others by two very singular characters. 1. Under the belly of the female there is a large cavity, in which she receives and suckles her young. 2. In both male and female the first toe of the hind feet has no claws, and is separated from the rest, like the thumb in the human hand; while the other toes of the same feet are placed near each other, and armed with crooked claws. The first character has been remarked by some travellers and naturalists, but the second has entirely escaped them. It was first observed by Edward Tyson, an English physician. He is the only author who has given a good description of the female; and a few years after, Mr. Cowper, a celebrated English anatomist, communicated to Tyson the observations he had made upon the male. Other authors, and particularly the nomenclators, who perpetually multiply species without necessity, have committed a number of blunders with regard to this animal, which we must endeavour to correct.

Our opossum is the same animal with the great oriental philander of Seba; for of all the animals of which Seba has given figures, and to which he applies the names of *philander*, *opossum*, or *carigueya*, this alone has the two characters of a pouch under the belly, and thumbs without claws on the hind feet. Neither is the opossum an eastern animal, but a native of the warm climates of the New World; for the two we have in the royal cabinet were brought from America. That of Tyson

was sent to him from Virginia. M. de Chanvallon, a correspondent of the Academy of Sciences at Martinico, who gave us a young opossum, recognised the other two to be real American opossums. It is agreed by all voyagers, that this animal is found in Brasil, New Spain, Virginia, the Antilles, &c. and none of them ever mention their having seen it in the East Indies. Hence Seba deceives himself, when he calls them the *oriental philanders*. He says, that this philander was sent him from Amboina along with other curiosities, under the name of *coes-coes;* but he allows at the same time that it had been brought to Amboina from some other remote country. This confession is alone sufficient to throw a suspicion on the denomination of *oriental philander;* for it is very probable that travellers may have transported this animal from America to the East Indies; and we have no proof of its being a native of Amboina; and the very passage quoted from Seba seems to indicate the contrary. The source of this error, in fact, as well as that of the name *coes-coes*, is to be ascribed to Piso, who says, that in Amboina there is an animal similar to the Brasilian opossum, which is called *cous-cous*. Piso mentions no authority for this assertion. It would be very singular, if it were true, that this animal is found in Amboina, and in no other part of the East Indies. Seba, on the contrary, remarks, that the one sent to him from Amboina was not a native of that place, but had been transported from a more distant country. But though he was ignorant of the region from which his philander was brought, he has presumed to give it the epithet of *oriental*. It is unquestionably, however, the same animal, as will appear from comparing his figure with nature. But what augments this error, at the same time that the author gives to the American opossum the name of the *great oriental philander*, he exhibits to us another animal, which he believes to be different from the former, and calls it the American philander; and yet, from his own description, it differs from the great oriental philander only in being smaller, and in having the spots above the eyes of a browner colour. These differences are too slight and too accidental to constitute distinct species; for he takes no notice of another difference, which, if it had any existence, would be much more essential, namely, that this American philander of Seba has a sharp claw upon the thumbs of the hind feet, while his great oriental philander has no claws on these thumbs. Now it is certain that our opossum, which is the true American one, has no claws on the hind thumbs. If any animal, therefore, with sharp claws on these thumbs existed, like that represented by Seba in his 36th plate, it could not, as he maintains, be the American opossum. But this is not all: Seba gives a third animal under the name of the *oriental philander;* of which, however, he makes no mention in his descriptions of the other two, but follows Francis Valentin, an author, as formerly remarked, who merits no confidence. This third animal is still the same with the two first. Hence it appears, that the three figures in Seba's 36th, 38th, and 39th plates, are one and the same animal; and it is probable, that the drawer from inattention has given sharp claws to the hind as well as to the fore thumbs, as in plates 36th and 38th, and that being more exact in plate 39th, he has represented the thumbs of the hind feet, as they really are, without claws. We are, therefore, persuaded that these three animals of Seba are only individuals of the same species, which is the same with that of our opossum, and that the slight differences in size and colour mentioned above proceed from age or from accident. The author himself allows, that the two animals in his 36th and 38th plates differ only in size and some shades of colour; and that the third, plate 39th, differs from the two former in being larger only, and having the spots above the eyes, instead of yellowish, of a brown colour. Seba remarks, 'That 'according to Francis Valentin the philander, plate '38th, is the largest kind found in the East Indies, and 'especially among the Malays, where it is called *pelun-'dor Aroe*, that is, *the rabbit of Aroe*, though Aroe is 'not the only place where these animals are to be met 'with; that they are common in the island of Solor; 'that they are reared along with the rabbits, to whom 'they do no harm; that their flesh, which is excellent, 'is eaten by the inhabitants,' &c. These facts are extremely questionable, not to say false. 1. The philander, plate 38th, is not the largest East India kind; for, according to our author, that represented in plate 39th, which he likewise attributes to the East Indies, is larger. 2. This philander has no resemblance to the rabbit; and, consequently, is improperly called *the rabbit of Aroe*. 3. No voyager to the East Indies makes mention of this remarkable animal; neither is it found in any other part of the Old Continent. Seba himself seems to perceive not only the incapacity, but the unfaithfulness of the author he quotes: but to give a complete demonstration of the little credit due to the testimony of Francis Valentin, who has written a history of the East Indies in five folio volumes, it is sufficient to refer to what is said of him by Artedi, and to the reproaches thrown upon his veracity by Seba himself. Valentin asserts, 'that the pouch 'of the philander is a uterus, in which the young are 'conceived; that after dissecting a female himself he 'could find no other; that if this pouch is not a real 'uterus the teats are to the young what the pedicles are 'to fruits; that they adhere to these teats till they are 'full grown, and then separate as the fruit from the 'pedicle, after it arrives at maturity,' &c. The truth is, that Valentin, who assures us that these animals are extremely common in the East Indies, and particularly in the island of Solor, had never seen one of them in that country; that all he has said, including his most con-

spicuous errors, he has copied from Piso and Marcgrave, who both copied from Ximenes, and are wrong in every article they have added of their own; for Marcgrave and Piso, as well as Valentin, assert, in the most positive tone, that the pouch is the true uterus where the young opossums are conceived. Marcgrave says, that he dissected a female, and found no other uterus. Piso goes farther, and tells us, that he dissected several females, and never could discover any internal uterus; and to this assertion he adds another equally false, that this animal is found in Amboina. Let men now judge what credit is due to Marcgrave, Piso, and Valentin, the first of whom has examined with no attention, the second has augmented the errors of the first, and the third has copied from both.

I ask pardon of my readers for this long critical discussion. But when errors are to be corrected, we can never be too exact, or too attentive, even to minute circumstances.

M. Brisson, in his account of quadrupeds, has implicitly adopted what he found in the works of Seba, and follows him both in his denominations and descriptions. He even proceeds a step farther than his author, when he makes three distinct species of the philanders, represented in plates 36, 38, and 39 of Seba; for if M. Brisson had examined the idea given by Seba, he would have found, that the latter does not exhibit his philanders as three distinct species. Seba never doubted, that an animal found in the warm climates of America would not also be found in the warm regions of Asia. He denominated his animals Oriental or American, according as they came to him from the one or the other continent. It is obvious, from the following passage, that he does not take the word *species* in a strict sense: 'This is the largest 'species of these animals:' he adds, 'This female is 'perfectly similar to the female philanders of America; 'it is only longer, and covered on the back with hair of 'a deeper yellow.' These differences, as formerly remarked, are accidental varieties only, which are common among individuals of the same species at different ages; and in fact Seba never pretended to make a methodical distribution of animals into classes, genera, and species. He gives only figures of the different specimens in his cabinet, which he distinguishes by numbers, according to any varieties he perceived in their size, the tints of their colours, or the countries from which he obtained them. It is apparent, therefore, that M. Brisson had no authority for making three species of philanders, especially as he gives no distinctive characters, and makes no mention of the want of claws on the thumbs of the hind feet. He says, in general, that the philanders have *claws*, without making any exception. The philander, however, which he saw in the royal cabinet, had no claws on the thumbs of the hind feet; and it appears to have been the only one he ever saw; since in his book there is no more than No. 1. marked with two asterisms. The chief error in Brisson's work is in the list of species, which is more numerous than that of nature.

M. Linnæus is the only other nomenclator we have to examine. In this article he is less exceptionable than in many others; for he has suppressed one of the three species of Seba. But he ought to have reduced them to one.

Edward Tyson dissected and described the female opossum with great accuracy. In his individual the head was six inches long, the body thirteen, and the tail twelve. The fore legs were six inches in length, and the hind legs four inches and a half. The circumference of the body was from fifteen to sixteen inches; and that of the tail, at its origin, three inches, and only one toward the extremity. The head across the eyes was three inches broad, gradually diminished to the nose, and resembled the head of a pig more than that of a fox. The orbits of the eyes were much inclined in the direction from the ears to the nose. The ears were rounded, and about an inch and a half long. The aperture of the mouth was two inches and a half, measuring from one of the angles of the lips to the end of the muzzle. The tongue was pretty narrow, three inches long, rough, and full of small papillæ, directed backward. There were five toes on the fore feet, all armed with crooked claws, and an equal number on the hind feet, four of which only had claws, and the fifth, which is the thumb, was separated from the rest, placed in a lower situation, and had no claw. There was no hair on the claws, which were covered with a reddish skin, and nearly an inch in length. The palm of the hands and feet was large, and there were fleshy callosities under all the toes. The tail was covered, for two or three inches from its origin, with hair, and afterwards to the end with a smooth scaly skin. The scales were whitish, nearly hexagonal, and regularly placed, so as not to encroach on each other, being all separated by a small circle of skin, which was of a browner colour than the scales. The ears were naked, thin, and membranous, like the wings of a bat; they were also very open, and the auditory canal was large. The upper jaw was a little longer than the under. The nostrils were large, the eyes small, black, prominent, and lively. The neck was short, the chest broad, and the whiskers like those of the cat. The hair on the fore part of the head was whiter and shorter than that on the body: the back and sides were ash-coloured, mixed with some small tufts of black and whitish hairs; the belly was browner, and the legs more dusky. Under the belly of the female there was an aperture about two or three inches long, formed by two folds of skin, which composed a pouch thinly covered with hair internally. This pouch contained the teats. The young, as soon as brought forth,

go into this pouch in order to suck the mother, and acquire so strong a habit of concealing themselves, that after arriving at a considerable size they continue to take refuge in the pouch whenever they are alarmed. This pouch the animal can open or shut at pleasure, which it performs by means of several muscles, and two bones that are peculiar to the opossum. These two bones are placed before the os pubis, to which they are attached by their base. They are about two inches long, and gradually diminish in thickness from the base to the extremity, and serve as a fulcrum to the muscles which open the pouch. The antagonists of these muscles shut the pouch so close, that in the living animal it cannot be seen unless when forcibly dilated by the fingers. In the inside of the pouch there are a number of glands, which secrete a yellowish substance of so disagreeable a smell that it infects the whole body of the animal. This matter, however, when dried, not only loses its disagreeable odour, but acquires a perfume which may be compared to that of musk. The pouch is not, as has been falsely asserted by Marcgrave and Piso, the place where the young are conceived. The female opossum has an internal uterus, which differs indeed from that of other animals, but where the young are conceived and retained till the moment of their birth. Tyson tells us, that in this animal there are two uteri, two vaginæ, four cornua uteri, four Fallopian tubes, and four ovaria. From the dissections of M. Daubenton, though he agrees not with Tyson in every article, it is certain that in the generative parts of the opossum there are several parts double, which are single in other animals. The glans penis of the male, and the glans clitoridis of the female, are forked, and have the appearance of being double. The vagina, which is single at its entrance, afterwards divides into two canals, &c. This structure is extremely singular, and differs from that of all other quadrupeds.

The opossum is an original native of the warm countries of the New World. He appears not, however, to be so strictly attached to warm climates as the armadillo; for he is found not only in Brasil, Guiana, and Mexico, but likewise in Florida, Virginia, aud other temperate regions of America. He is a very common animal; because the female produces often, and according to most authors four or five, some say six or seven at a time. Marcgrave assures us, that he has seen six living young in the pouch of the female. These young ones were about two inches long, very agile, and came out and went into the pouch several times a day. When new born they are very small. According to some travellers, when they escape from the uterus, go into the pouch, and attach themselves to the teats, they exceed not the size of flies.

[The female opossum has a double belly, or rather a pendulous membrane that covers the whole belly, without being fixed to it, the inside of which may be seen after the animal has once brought forth. At the hinder part of this membrane there is an aperture, into which the hand may be introduced. It is here where the young retire, either to avoid danger, or for the purposes of sucking and sleeping. In this manner they live till they are able to procure food for themselves. I have seen young ones attached to the teats when they exceeded not the size of a fly. They never quit the teats till they are as large as mice.—*Hist. de la Virginie.*]

This fact is not so much exaggerated as might naturally be imagined; for we have seen in an animal whose species has a great affinity to that of the opossum, young attached to the teats which were not bigger than large beans; and it is probable, that in this animal the uterus is only a place destined for the conception and first formation of the fœtus, the exclusion of which being earlier than in other quadrupeds, its growth is finished in the pouch, where it enters the moment after its premature birth. No person has ascertained the time of gestation in the female opossum, which is probably much shorter than in any other quadruped: and as this premature exclusion of the fœtus is a singularity of nature, we must earnestly recommend it to those who have an opportunity of observing the opossum in its native country, to endeavour to discover the time the females go with young, and, after birth, how long the young ones remain attached to the nipples. This last observation is both curious in itself, and may be productive of utility: from it we may perhaps learn some method of preserving the lives of infants who come into the world before the natural period.

That the young opossums, therefore, continue attached, and pasted, as it were, to the teats of the mother, till they acquire strength and growth sufficient to enable them to move about with ease, is a fact no longer to be doubted. Neither is it peculiar to this species, as will appear from the history of the *marmose* or murine opossum, which is given in the next article. The female of this last species has no pouch under its belly, like the female of the former. It is not, therefore, to the conveniency of a secure retreat, afforded by the pouch, that the effects of adhering long to the teats, and acquiring growth in this immoveable situation, are to be ascribed. I make this remark to prevent the pouch from being regarded as a second uterus, or at least as a shelter indispensably necessary to young which are prematurely brought forth. Some authors mention, that the young remain fixed to the teats for several weeks. [The young are attached to the teats, and remain several weeks in this situation, till they acquire strength, the use of their sight, and a proper covering of hair. They then fall into the membrane, from which they go out and return at pleasure.—*Hist. de la Virginie.*]

Others say, that they continue in the pouch during the first month of their age only. It is an easy operation

to open the pouch of the mother, and to examine and count the young without incommoding them. They never quit the teats, which they hold with their mouths till they have strength enough to walk. They then fall into the pouch; and afterwards go out in quest of food. They often return to the pouch to sleep, to suck, and to conceal themselves when danger is apprehended; then the mother flies, carrying her whole offspring along with her. Her belly seems not to be enlarged till long after she has brought forth, and till the young have acquired some bulk; for during the time of gestation her size is not perceptibly augmented.

[After bringing forth the mother puts her offspring into the pouch. They instantly fix upon the teats, and continue to feed upon the milk in this secure and warm retreat. As soon as they are able to move about upon the grass, the mother opens her pouch and allows them to escape, &c.—*Mem. de la Louisiane.*

The mother brings forth her young blind and naked, and with her fore paws puts them into the pouch, which is a kind of uterus, where they find an agreeable warmth, &c. She takes them not out of this pouch till they have the use of their eyes. She then carries them to some rising ground where no danger is to be apprehended; and having opened her pouch, she makes them come out, exposes them to the rays of the sun, and amuses them by sporting and playing. Upon the smallest noise or suspicion of danger she soon recalls them by a cry, *tic, tic, tic,* and they run into the pouch for shelter.—*Seba,* vol. i. p. 56.

When the mother hears any suspicious noise, she gives a signal by a certain cry, which the young understand, run instantly to their protector, and return into the pouch.—*Mem. de la Louisiane.*]

From inspecting the form of the feet it is easy to perceive that these animals must walk ill and run slowly. A man, accordingly, it is said, may easily seize them without accelerating his pace. As a compensation, however, they climb trees with great facility, and conceal themselves among the leaves in order to seize birds; or rather they suspend themselves on a branch by the tail, which is so muscular and flexible, that it is capable of wrapping round any thing it seizes more than once. In this situation, with his body suspended, and his head hanging downwards, he will remain very long, waiting for the approach of small birds. At other times he leaps from one tree to another, nearly in the same manner as the monkeys with prehensile tails, whom he also resembles in the structure of his feet.

[He is very fond of birds and poultry; and accordingly he enters boldly into the court-yards and hen-houses. He even goes into the fields to eat the mahi which is sown there. The instinct with which he hunts his prey is extremely singular. After killing a small bird he does not eat it immediately, but lays it down in an exposed situation near a tree. He then mounts the tree, suspends himself by the tail in a branch which is nearest to the bird, and waits patiently till some carnivorous bird comes to carry it off, upon which he instantly darts, and makes a prey of both.—*Mem. de la Louisiane.*

He hunts during the night; and wages war against the poultry, whose blood he sucks, but does not eat the flesh.—*Hist. de la Louisiane.*]

Though carnivorous, and even greedy of blood, he eats, reptiles, insects, sugar canes, potatoes, roots, and the leaves and bark of trees. He might easily be reared as a domestic animal; for he is neither mischievous nor ferocious, and is easily tamed. But he disgusts by his smell, which is ranker than that of a fox. His figure is also disagreeable; for his ears resemble those of the ounce, his tail is like a serpent, his mouth stretches near to his eyes, and his body has always a dirty appearance; because his hair, which is neither smooth, nor curled, seems as if it were covered with dung. The offensive odour proceeds from his skin; for his flesh is not bad. He is one of those animals to which the savages give a preference in their hunting, and whose flesh they eat with pleasure.

SUPPLEMENT.

M. de la Borde, king's physician at Cayenne, informs me, that he fed three opossums in a small cask, where they suffered themselves to be managed with ease. They eat fish, flesh raw or roasted, bread, biscuit, &c. They licked each other perpetually, and made the same purring noise as cats do when caressed.

'I did not perceive,' says he, 'that they had any bad 'smell. Some species are large and others small. They 'all carry their young in a pouch under their bellies; 'and the young never quit the teats, even when sleeping. The dogs kill, but do not eat these animals. 'They make a kind of grunting noise, which extends to 'no great distance. They are easily tamed. They go 'into the hen-houses and devour the fowls. Their flesh 'is not good to eat: in certain species its odour is so 'insupportable, that the animal receives the epithet of '*stinking* from the inhabitants of Cayenne.'

[There was lately sent to the Royal Cabinet, from Cayenne, a skin of one of these small opossums, which, though the animal was an adult, exceeded not three inches and a half in length, and the tail was four inches and a half long.]

These stinking opossums must not be confounded with the true *mouffettes,* or stinking weasels, which constitute a very different genus of animals.

M. de Vosmaer, director of the Prince of Orange's cabinet of Natural History, has added a note to page 6, of his description of a flying squirrel, published at

Amsterdam in the year 1767, in which he says; 'The 'coescoes is the *bosch* or *beusrult* of the East Indies, the 'philander of Seba, and the *didelphis* of Linnæus. The 'learned M. de Buffon denies absolutely its existence in 'the East Indies, and limits it entirely to the New 'World. We can, however, assure this learned natu- 'ralist, that Valentin and Seba were right in making 'these animals common to Asia and America. Last 'summer I myself received a male and female from 'the East Indies. The same species has likewise been 'transmitted from Amboina to Doctor Schlosser of 'Amsterdam. The chief difference between the *coescoes* 'of the East and that of the West Indies consists, ac- 'cording to my observation, in the colour of the hair, 'which in the East India male is all of a yellowish 'white: that of the female is a little browner, with a 'black or rather brown line on the back. The head of 'the West India kind is shorter; but the head of the 'male appears to be longer than that of the female. 'The ears of the East are much shorter than those of 'the West India species. The description of the second 'species, mentioned by Valentin, is too diffuse to afford 'any certain information.'

That M. Vosmaer received male and female animals from the East Indies, under the denomination of *coescoes*, I have no reason to doubt. But the differences which he himself points out between the coescoes and the opossums may lead us to conclude that they are not animals of the same species. I acknowledge, however, that M. de Vosmaer's criticism is just, when he remarks, that I made Seba's three philanders the same animal, whilst, in fact, the third, represented in his 39th plate, is a different species, and is found in the Philippine Islands, and perhaps in some other parts of the East Indies, where it is known by the name of *coescoes*, *cuscus*, or *cusos*. In the voyage of Christopher Barchewitz I find the following notice:

'In the island of Lethy there are *cuscus* or *cuscos*, 'whose flesh has nearly the taste of that of a rabbit. In 'colour they resemble the marmot. The eyes are small, 'round and brilliant. The legs are short; and the tail, 'which is long, has no hair on it. This animal leaps 'from one tree to another, like the squirrel, and then 'fixes its tail round a branch, that it may eat the fruit 'more commodiously. It diffuses a disagreeable odour, 'like that of the fox. The female has a pouch under the 'belly, into which her young go out and in below her 'tail. She leaps from one tree to another, conveying 'her young in this pouch.'

From the pouch under the belly, and the prehensile tail, it appears, that the cuscus or cusos of the East Indies is really an animal of the same genus with the American opossum. But this is by no means a proof that it belongs to the same species with any of those which inhabit America. This would be the only example of such a coincidence. If M. Vosmaer had engraven the figure of these coescoes, as he mentions in the text, we would have been enabled to form a more complete notion of the similarities and differences which subsist between the Asiatic coescoes and the American opossums. But I am still persuaded that those of the one continent will never be found in the other unless they are transported thither. I refer the reader to what I have before said on this subject.

We mean not to deny the possibility of equal climates in both continents, producing some animals of the precise same species. We formerly remarked, that the same temperature in different parts of the globe should produce the same beings, both in the animal and vegetable kingdoms, if all other circumstances were equal. We treat not here however of philosophical possibilities, which may be more or less probable, but of a very general fact, of which numberless examples may be given. It is certain, that when America was discovered, none of the following animals existed in the New World; the elephant, the rhinoceros, the hippopotamus, the camelopard, the camel, the dromedary, the buffalo, the horse, the ass, the lion, the tiger, the apes, the baboons, and a number of others which I have formerly enumerated. In the same manner, the tapir, the lama, the pecari, the jaguar, the couguar, the agouti, the paca, the coati, the sloth, and several others formerly mentioned, did not exist in the Old Continent. Is not this multitude of examples sufficient to guard us against pronouncing, like M. Vosmaer, that such and such animals belong equally to the southern regions of both worlds?

The following passage should be referred to the Indian cuscus or cusos:

'In the Molucca islands,' Mandelslo remarks, 'there 'is an animal called *cusos*, which dwells on trees, and 'feeds on their fruits. It resembles a rabbit, and has 'thick, frizzled, coarse hair, of a mixed colour between 'gray and red. The eyes are round and vivacious, the 'feet small, and the tail so strong that the animal hangs 'by it on the branches, in order the more easily to reach 'the fruit.'

In this passage no mention is made of the pouch under the belly, which is the most distinguishing character of the opossums. But I still maintain, that if the cusos of the East Indies has this character, it is certainly a species which approaches very near to the American opossums; and I shall be inclined to think that it differs from the opossum nearly in the same manner as the jaguar differs from the leopard. Of all the animals belonging to the southern climates of both continents, the two last, without being of the same species, make the nearest approach to each other.

THE MURINE OPOSSUM.

THIS opossum has long broad ears rounded at the end, and thin and naked. The eyes are encompassed with black. The face, head, and upper part of the body are of a tawny colour, and the belly of a yellowish white. The feet are covered with short whitish hair. The toes are formed like those of the preceding species. The tail is slender, and covered with minute scales to the very rump. The length from nose to tail is about six inches and a half, and that of the tail the same. The female wants the pouch or false belly; but on the lower part the skin forms on each side a fold, between which the teats are lodged. This species varies in colour. I have seen one from Guiana, which was brown above and whitish beneath.

This species seems to make a very near approach to the former. They both belong to the same climate and to the same continent. They likewise resemble each other in the form of the body, in the structure of the feet, in the *prehensile* tail, which is covered with scales through its whole extent, except at its origin, where it is covered with hair, and in the arrangement of the teeth, which are more numerous than in other quadrupeds. But the murine opossum is much smaller, and its muzzle is sharper: the female has no pouch under the belly; there are only two longitudinal folds near the thighs, between which the young attach themselves to the teats. The parts of generation, both of the male and female, resemble in their form and position those of the Virginian opossum. The glans of the male is also forked and placed in the anus; and this last aperture seems likewise in the female to be the orifice of the vagina. The birth of the young in this species seems to be still more premature. When they are brought forth, and attach themselves to the teats, they are hardly so large as small beans. The litter is also more numerous; I have seen ten young, each of them fixed to a separate teat, and yet the mother had four teats unoccupied; so that in all she had no less than fourteen teats. It is upon females of this species that the observations recommended in the preceding article ought chiefly to be made; for I am persuaded that they bring forth a few days after conception, and that the young, at the time of exclusion, are only fœtuses, as they exceed not one fourth part of the growth which fœtuses generally acquire at that period. The delivery of the mother is always a very early abortion, and the fœtuses preserve their lives solely by fixing to the teats, and never quitting their hold, till they attain that degree of strength and growth which they would have naturally acquired in the uterus if they had not been thus prematurely excluded.

The murine opossum has the same dispositions and manners as the Virginian species. They both dig holes, burrow in the ground, fix themselves to the branches of trees by the extremities of the tail, and dart upon birds and small animals. They likewise eat fruits, grain, and roots. But they prefer fish and crabs, which, it is said, they catch with their tails. This fact is extremely doubtful, and accords not with the natural stupidity ascribed to these animals, which, according to the testimony of most travellers, can neither move, nor fly, nor defend themselves with any measure of dexterity.

THE MEXICAN OPOSSUM.

THIS animal has large, angular, transparent ears. Its nose is thicker than that of the former kind. There is a slight border of black round the eyes. The hairs on the head and upper part of the body are ash-coloured at the roots, and tawny at the tips. The belly and legs are whitish. The tail is long, pretty thick, varied with brown and yellow, hairy near an inch from its origin, and the rest is naked. The length from nose to tail is about seven inches and a half, and that of the tail more than eleven.

This animal was first taken notice of by Fernandes. The cayopollin, says he, is a small animal about the size of a rat. It resembles the opossum in the muzzle, the ears, and the tail, which last it uses as a hand. The ears are thin and transparent. The legs and feet are white. The young when frighted lay fast hold of the mother, who carries them up to the nearest tree. This species is found in the mountains of New Spain. Nieremberg has copied these remarks verbatim, without adding any of his own. Seba, who first gave a figure of this animal, has not described it. He only says, that its head is somewhat thicker, and its tail larger than those of the marmose or murine opossum, and that, though it be of the same genus it belongs to a different climate, and

even to a different continent. He then refers to Nieremberg and Johnston for farther information concerning this animal. But it is evident that neither Nieremberg nor Johnston had ever seen it; for they only follow Fernandes. None of these three authors say that it is a native of Africa. They mention it, on the contrary, as peculiar to the mountains of the warm regions of America; and yet Seba, without the smallest authority, pretends that it is an African animal. That which we saw unquestionably came from America. It was larger, the muzzle was not so sharp, and the tail was longer than those of the murine opossum, and in every particular it approached nearer than the latter to the Virginian opossum. These three animals have a great resemblance in their external and internal structure, in the supernumerary bones of the pelvis, in the form of the feet, in their premature birth, in their long and constant adherence to the teats, and in their manners and dispositions. They all belong to the same climate of the New World. They are never found in the cold regions of America, and cannot live even in temperate climates. Besides, they have all an ugly aspect. Their mouth, which is split like that of a pike, their ears, which resemble those of a bat, their serpent-like tail, and their feet, shaped like those of a monkey, exhibit a strange picture, which is rendered still more disagreeable by their offensive smell, and by the slowness and stupidity that accompany all their actions and movements.

THE ELEPHANT.

THE elephant has a long cartilaginous trunk, formed of multitudes of rings, pliant in all directions, and terminated with a small moveable hook. The nostrils are at the end of the trunk, which is used, like a hand, to convey any thing into the mouth. This animal has no cutting teeth, but four large flat grinders in each jaw, and in the upper two vast tusks pointing forwards, and bending a little upwards; the largest of them imported into Britain are seven feet long, and weigh 152 pounds each. The eyes are small, and the ears long, broad, and pendulous. The back is much arched. The legs are thick, and very clumsy and shapeless. The feet are undivided; but their margins are terminated by five round hoofs. The tail is like that of a hog. The colour of the skin is dusky, with a few scattered hairs on it.

If the human species be excepted the elephant is the most respectable animal in the world. In size he surpasses all other terrestrial creatures; and by his intelligence he makes as near an approach to man as matter can approach spirit. Of all animated beings the elephant, the dog, the beaver, and the ape, have the most admirable instinct. But this instinct, which is only a result of all the animal powers, both internal and external, manifests itself by very different effects in each of these species. Naturally, and when left at full liberty, the dog is as cruel and bloody as the wolf; but amidst all this ferocity of disposition there is one flexible point which we have cherished. Hence the natural dispositions of the dog differ not from those of other rapacious animals, but by this point of sensibility, which renders him susceptible of affection and attachment. It is from nature that he derives this germ of sentiment, which man has cultivated and expanded by living long and constantly in society with this animal. The dog alone was worthy of this distinguished regard; for being more susceptible of foreign impressions than any other quadruped, all his relative powers have been brought to perfection by his commerce with man. His sensibility, his docility, his courage, his talents, and even his manners, are modified and formed by the example and qualities of his master. We ought not, therefore, to ascribe to him all the powers he appears to possess. His most brilliant qualities are borrowed from us. He has acquired more than other animals, because he is more capable of making acquisitions. Instead of having a repugnance to man he has a natural bias in favour of the human race. This gentle sentiment, which is always alive, is made evident by the desire of pleasing, and has produced docility, fidelity, perpetual submission, and at the same time that degree of attention which is necessary for acting accordingly, and for giving ready obedience to all the commands he receives.

The ape, on the contrary, is as untractable as he is extravagant. His nature, in every point, is equally stubborn. He has no relative sensibilities, no gratitude, no recollection of good treatment, or of benefits received. Averse to the society of man, and to every kind of restraint, he has a violent propensity to do every thing that is hurtful or displeasing. But these real faults are compensated by apparent perfections. In his external figure he resembles man; he has arms, hands, and fingers. The use of these parts alone renders him superior in address to other animals; and the relations they give him to us in similarity of movements and conformity of actions please and deceive us, and lead us to

ascribe to internal qualities what depends solely on the structure of his members.

The beaver, whose individual qualities seem far inferior to those of the dog and ape, has notwithstanding received from nature a gift almost equivalent to that of speech. He makes himself so well understood to his own species that they unite in society, act in concert, undertake and execute large and long continued works; and this social attachment, as well as the result of their mutual intelligence, are more entitled to our admiration than the address of the ape or the fidelity of the dog.

Hence the genius of the dog (if I may be permitted to profane this term) is borrowed; the ape has only the appearance of it; and the talents of the beaver extend no farther than to what regards himself and his associates. But the elephant is superior to all the three; for in him all their most exalted qualities are united. In the ape the hand is the principal organ of address. The trunk of the elephant affords him the same means of address as the ape. It serves instead of an arm and a hand; and by it he is enabled to raise and lay hold of small as well as of large objects, to carry them to his mouth, to place them on his back, to embrace them fast, or to throw them at a distance. He has, at the same time, the docility of the dog, and, like that animal, he is susceptible of gratitude, capable of attachment, is easily accustomed to man, submits less by force than good treatment, serves him with zeal, fidelity, knowledge, &c. In fine, the elephant, like the beaver, loves the society of his equals, and can make himself to be understood by them. They are often observed to assemble together, to disperse, and to act in concert; and if they receive no mutual edification, if they carry on no common operation, it must perhaps be ascribed to the want of room and of tranquillity; for men have been very anciently multiplied in all the countries inhabited by the elephant; he is therefore perpetually disturbed, and is no where a peaceable possessor of sufficient space to establish a secure abode. We have seen that all these advantages are necessary to unfold the talents of the beaver, and that in every place frequented by men he loses his industry, and receives no edification from associating. Every being has its relative value in nature. To form a just estimation of the elephant, he must be allowed to possess the sagacity of the beaver, the address of the ape, the sentiment of the dog, together with the peculiar advantages of strength, largeness, and long duration of life. Neither should we overlook his arms or tusks, which enable him to transfix and conquer the lion. We should also consider, that the earth shakes under his feet; that with his hand he tears up trees; that by a push of his body he makes a breach in a wall; that though tremendous in strength he is rendered still more invincible by his enormous mass, and by the thickness of his skin; that he can carry on his back an armed tower filled with many warriors; that he works machines and carries burdens which six horses are unable to move; that to this prodigious strength he adds courage, prudence, coolness, and punctual obedience; that he preserves moderation even in his most violent passions; that he is constant and impetuous in love; that when in anger he mistakes not his friends; that he never attacks any but those who offend him; that he remembers favours as long as injuries; that having no appetite for flesh he feeds on vegetables alone, and is born an enemy to no living creature; and, in fine, that he is universally beloved, because all animals respect, and none have any reason to fear him.

[The strength of the elephant is so amazing that it can only be known from experience. I have seen an elephant carry on his tusks two cannons, fixed together with cables, each weighing three thousand pounds, which he first raised from the ground, and then carried them to the distance of five hundred paces. I have also seen an elephant draw ships and gallies upon land in order to set them afloat.—*Voy. de Fr. Pyrard.*]

Men likewise in all ages have had a kind of veneration for this first and grandest of terrestrial creatures. The ancients regarded him as a miracle of nature; and indeed he is her highest effort. But they have greatly exaggerated his faculties. They have without hesitation, ascribed to him intellectual powers and moral virtues. Pliny, Ælian, Solinus, Plutarch, and other authors of a more modern date, have given to these animals rational manners, a natural and innate religion, a kind of daily adoration of the sun and moon, the use of ablution before worship, a spirit of divination, piety towards heaven and their fellow-creatures, whom they assist at the approach of death, and after their decease bedew them with tears, cover them with earth, &c. The Indians, prejudiced with the notion of the metempsycosis or transmigration of souls, are still persuaded that a body so majestic as that of the elephant must be animated with the soul of a great man or a king. In Siam, Laos, Pegu, &c. the white elephants are regarded as the living *manes* of the Indian emperors. Each of these animals has a palace, a number of domestics, golden vessels filled with the choicest food, magnificent garments, and they are absolved from all labour and servitude. The emperor is the only personage before whom they bow the knee, and their salute is returned by the monarch. By all these attentions, honours, and marks of respect, they are flattered but not corrupted. This circumstance alone should be sufficient to convince the Indians that these animals are not endowed with human souls.

[M. Constance conducted the ambassador to see the white elephant which is so esteemed in India, and has given rise to so many wars. He is very small, and so old that he is all wrinkled. Several mandarins are appointed to take care of him, and his victuals are served

up to him in large golden vessels. His apartment is magnificent, and the inside of it is handsomely gilded.—*Premier Voyage du P. Tachard.*

In a country-house belonging to the king, situated upon the river about a league from Siam, I saw a small white elephant, which was destined to be successor to the one in the palace, which is said to be three hundred years old. This little elephant is somewhat larger than an ox, and is attended by many mandarins; and out of respect to him his mother and aunt are kept along with him.—*Idem.*

When the king of Pegu walks abroad, four white elephants, adorned with precious stones and ornaments of gold, march before him.—*Recueil des Voyages de la Compagnie des Indes d'Hollande.*

When the king of Pegu gives audience, the four white elephants are presented to him, who do him reverence by raising their trunks, opening their mouths, making three distinct cries, and then kneeling. When raised they are led back to their stables, and there each of them are fed in large golden vessels. They are twice a-day washed with water taken from a silver vessel. During the time of their being dressed in this manner, they are under a canopy supported by eight domestics, in order to defend them from the heat of the sun. In going to the vessels which contain their food and water, they are preceded by three trumpets, and march with great majesty, regulating their steps by music, &c.—*Idem.*

White elephants are held to be sacred by the natives of Pegu: having learned that the king of Siam had two, they sent ambassadors offering any price that should be demanded for them. But the king of Siam would not sell them. His Majesty of Pegu incensed at this refusal, came with his army, and not only carried off the elephants by force, but rendered the whole country tributary to him.—*Idem.*]

After removing the fabulous credulities of antiquity, and the puerile fictions of superstition, which still exist, the elephant, even to philosophers, possesses enough to make him be regarded as a being of the first distinction. He deserves to be known, and to be studied. We shall, therefore, endeavour to write his history with impartiality. We shall first consider him in a state of nature, when he is perfectly free and independent, and afterwards in a state of servitude, when the will of his master is partly the motive of his actions.

In a wild state elephants are neither sanguinary nor ferocious. Their dispositions are gentle, and they make not a wrong use of their arms or their strength; for they never exert them but in defending themselves, or in protecting their companions. Their manners are social; for they are seldom seen wandering alone. They generally march in troops, the oldest keeping foremost, and the next in age bringing up the rear. The young and feeble are placed in the middle. The mothers carry their young firmly embraced in their trunks. They observe not this order except in perilous marches, when they want to pasture on cultivated fields. In the deserts and forests they travel with less precaution, but without separating so far as to exceed the possibility of receiving assistance from one another. Some of them, however, occasionally wander or lag behind the troop; and it is these alone whom the hunters dare attack; for a little army is necessary to assail a whole troop; and they are never vanquished but at the expence of several lives. It is even dangerous to do them the smallest injury; for they run straight upon the offender, and though the weight of their bodies be great, their steps are so long that they easily overtake the most agile man. They then transfix him with their tusks, or laying hold of him with their trunk throw him against a stone, and put an end to his existence by trampling him under their feet. But it is when provoked only that they kill men in this manner, and never injure those who do not disturb them. But as they are extremely suspicious and sensible of injuries, it is proper to avoid them; and the travellers who frequent the countries inhabited by elephants kindle fires during the night, and beat drums to prevent their approach. When they have been once attacked by men, or have fallen into a snare, they are said never to forget it, but take every opportunity of revenge. As their sense of smelling is perhaps more perfect than that of any other animal, the smell of a man strikes them at a great distance, and they can easily follow him by the scent. The ancients relate, that the elephants tear the grass off the ground upon which the hunters had passed, and that they hand it about to each other for the purpose of receiving information concerning the passage and march of the enemy.

[I still tremble when I think of the danger to which we exposed ourselves in pursuing a wild elephant; for though there were only ten or a dozen of us, the one half of which were not well armed, if we could have come up with him we should have been foolish enough to make the attack. We thought we might kill him by two or three shot. But I afterwards saw that this business requires two or three hundred men.—*Voyage de Guinee, par Guillaume Bosman.*

The Negroes unanimously relate, that the elephants, when they meet any person in the woods, do him no harm unless they are attacked; but that when shot at, and not mortally wounded, they become extremely furious.—*Idem.*

The wild elephant is provoked to pursue a man, and is then caught in a pit-fall.—*Voyage de Siam.*

Those who hurt or insult an elephant should be much on their guard; for these animals do not easily forget injuries till they accomplish their revenge.—*Recueil des Voyages de la Compagnie des Indes d'Hollande.*]

These animals love the banks of rivers, deep valleys, and shady moist places. They cannot dispense with water, which they trouble before they drink. They often fill their trunk with water, either to carry it to their mouth, or solely for refreshing their nose, and amusing themselves by throwing it back into the river, or besprinkling it around. They cannot support cold, and likewise suffer by extreme heat. To avoid the ardour of the sun's rays, they retire into the most shady recesses of the forests. They frequently take to the water: the enormous size of their bodies rather aids than retards their swimming; for they sink not proportionably so deep as other animals; and the length of their trunk, which they hold up in the air, and through which they respire, removes from them all apprehensions of being drowned.

Roots, herbs, leaves, and tender wood, are their common food. They likewise eat grains and fruits. But they disdain flesh and fish. When one of them discovers a plentiful pasture he calls to the others, and invites them to eat with him.

[The most savage of these animals eat no flesh, but live solely upon leaves, branches, and twigs of trees, which they break off with their trunk, and even browse pretty strong wood.—*Voyage de Fr. Pyrard.*]

As they require a vast quantity of forage they often change their place of pasturing; and when they come upon cultivated fields they do incredible damage. Their bodies being of an enormous weight they destroy ten times more with their feet than they use for food, which generally amounts to one hundred and fifty pounds of grass a day; and as they always go in troops, they lay a whole country waste in a single hour. For this reason the Indians and Negroes use every artifice to prevent the approach of these animals, or to fright them away. They make great noises, and kindle large fires round their cultivated fields. But notwithstanding these precautions, the elephants sometimes pay them a visit, drive off the domestic cattle, put the men to flight, and not unfrequently overturn their limber habitations. It is difficult to scare them; and they are not susceptible of fear. Nothing can surprise them, or stop their progress, but artificial fires or crackers, which the natives throw at them, and the sudden and repeated noise sometimes induces them to turn back. It is not easy to make them separate from each other; for they generally act in concert, whether they attack, march, or fly.

When the females come in season this attachment to society yields to a stronger passion. The troop separates into pairs which love had previously formed. They unite from choice, steal off in quest of retirement, and their march seems to be preceded by love, and followed by modesty; for all their pleasures are accompanied with the profoundest mystery. They have never been detected in their amours. They anxiously avoid the presence or inspection of their neighbours; and know perhaps better than the human race how to enjoy pleasure in secret, and to be entirely occupied with a single object. They search for the deepest solitudes of the woods, that they may give full vent, without disturbance or reserve, to all the impulses of nature, which are lively and durable, in proportion to the long interval of abstinence. The female goes with young two years: when impregnated the male abstains; and his season of love returns but once in three years. The females produce only one young, which, at the moment of birth, has teeth, and is as large as a wild boar. There is no appearance, however, of the horns or tusks. Soon after they begin to shoot; and at the age of six months they are several inches long. The animal is then larger than an ox, and the tusks continue to grow and enlarge till the most advanced age, provided the creature enjoys health and liberty; for it is not to be imagined what changes may be introduced into the temperament and habits of the elephant by slavery and unnatural food. They are easily tamed, instructed, and rendered submissive; and as they are stronger and more intelligent than any other animal, their service is more ready, more extensive, and more useful. But the disgust arising from their situation is probably never eradicated: for though they feel from time to time the most lively impressions of love, they neither intermix nor produce in a domestic state. Their constrained passion degenerates into fury. Being unable to gratify themselves without witnesses, they fret, lose patience, and at last their indignation becomes so violent that the strongest chains and fetters of every kind are necessary to repress their movements and to allay their rage. Hence they differ from all other domestic animals, who are managed by men as if they had no will of their own. They are not of the number of those born slaves which we propagate, mutilate, or multiply, purely to answer our own purposes. Here the individual alone is a slave. The species remain independent, and uniformly refuse to augment the stores of their tyrants. This circumstance shows the elephant to be endowed with sentiments superior to the nature of common brutes. To feel the most ardent passion, and at the same time to deny the gratification of it, to experience all the fury of love, and not to transgress the laws of modesty, are perhaps the highest efforts of human virtue; and yet in these majestic animals they are only common and uniform exertions. The indignation they feel because they cannot be gratified in secret becomes stronger than the passion of love, suspends and destroys the effects of it, and at the same time excites that fury which during these paroxysms renders them more dangerous than any wild animal.

We are inclined, were it possible, to doubt of this fact; but all naturalists, historians, and travellers, concur in assuring us, that the elephants never produce in

a domestic state. The princes of India keep great numbers of elephants; and after many fruitless attempts to multiply them, like other domestic animals, they found it necessary to separate the males from the females, in order to diminish the frequency of those ineffectual ardours which are always accompanied with fury.

[It is remarkable that the male never covers the female, though she indicates the strongest marks of desire, in situations where they may be exposed to the observation of men.—*Voyage de Fr. Pyrard.*

The elephants never couple but in secret, and produce only one at a birth.—*Cosmographie du Levant.*]

Hence there are no domestic elephants which have not formerly been wild; and the manner of taking, taming, and rendering them submissive, merits particular attention. In the midst of the forest, and in the neighbourhood of places frequented by the elephants, a spot is chosen, and surrounded with strong pallisades. The largest trees of the wood serve as the principal stakes, to which are fixed cross bars that support the other stakes. A large opening is left, through which the elephant may enter; and over this door there is a trap, or rather it receives a strong bar, which is shut after the animal passes. To draw him into this enclosure the hunters go in quest of him; they carry along with them into the forest a tamed female in season; and when they imagine themselves to be near enough to be heard her governor makes her utter the cry of love. The wild male instantly replies, and hastens to join her. She is then made to march towards the enclosure, repeating the cry from time to time. She arrives first, and the male, following her by the scent, enters by the same port. As soon as he perceives the hunters, and sees himself surrounded, his ardour vanishes, and is changed into fury. Ropes and fetters are thrown round his legs and trunk. Two or three tamed elephants, conducted by men expert in that business, are brought to him, and they endeavour to fix him to one of these animals. In fine, by address, by force, by torture, and by caresses, he is tamed in a few days. I will not enter into a more particular detail, but content myself with quoting from those travellers who have been eye-witnesses of the hunting of elephants, which differs in different countries, and according to the strength and dexterity of the people who make war against them; for instead of making, like the king of Siam, walls, terrasses, pallisades, parks, and vast enclosures, the poor Negroes content themselves with the most simple artifices. They dig, in the places where the elephants are supposed to pass, ditches so deep, that after falling into them there is no possibility of getting out.

[I went to see the grand hunting of the elephants, which was performed in the following manner: the king sent a great number of women into the woods; and when the report was brought that they had discovered a troop of elephants, he dispatched thirty or forty thousand men, who made a large circle round the place. They posted themselves in fours, at the distance of twenty or twenty-five feet from each other, and at every station they kindled a fire, which was raised about three feet above the surface of the earth. There was another circle composed of elephants trained to war, distant from one another about a hundred or a hundred and fifty paces; and in such places as the wild elephants might most easily escape, the war elephants were posted closer. There were cannons in several places, which are discharged when the wild elephants attempt to force a passage; for they are terrified at fire. This circle is daily diminished, and at last becomes so small that the fires are not above five or six paces distant. As the elephants hear a great noise all round them, they dare not fly, though it is not uncommon for some of them to make their escape; for I was told that ten of them got off in one day. When the hunters want to seize them, they are made to enter a place surrounded with stakes, where there are also some trees, between which a man can easily pass. There is another circle of war elephants and soldiers, into which some men enter mounted on elephants, who are extremely dexterous in throwing ropes round the hind legs of these animals. When fixed in this manner, the wild elephant is put between two tame elephants, and a third one is appointed to push him behind in such a manner as obliges him to go forward; and when he grows mischievous the others give him blows with their trunks. He is then led off into captivity; and the others are seized in the same manner. I saw ten of them taken. The king was present, and gave every necessary order.—*Relation de l'Ambassade de M. Chevalier de Chaumont a la cour du Roi de Siam.*

At a quarter of a league from Luovo there is a kind of large amphitheatre, of a rectangular figure, surrounded with high terrass walls, upon which the spectators are placed. Within these walls there is a pallisade of strong posts fixed in the ground, behind which the hunters retire when pursued by the enraged elephants. A large opening is left on the side next the fields, and opposite to it, next the city, there is a smaller one, which leads to a narrow alley, through which an elephant can pass with difficulty, and this alley terminates in a large shade where the operation of taming is finished. When the day destined for the chase arrives, the hunters enter the woods mounted on female elephants trained to this exercise. The men cover themselves with leaves of trees to prevent their being observed by the wild elephants. When they have advanced into the forests, and think that some elephants may be in the neighbourhood, they make the females utter certain cries, fitted to allure the males, who instantly reply by frightful roarings. Then the hunters, when they perceive the elephants at a proper distance, return, and lead the females gently

back toward the amphitheatre above described. The wild elephants never fail to follow. The male which we saw tamed entered the inclosure spontaneously along with the females, and the passage was immediately shut. The females continued their march across the amphitheatre, and filed off one by one into the narrow alley at the other end. The wild elephant, who had followed them all along, stopped at the entrance of this defile. Every method was tried to make him enter. The females, who were now beyond the alley, were made to cry. Some Siamese irritated him by clapping their hands and crying *pat, pat.* Others teaze him with long poles armed with sharp points; and when pursued they slip through between the posts, and conceal themselves behind the pallisade, which the elephant cannot surmount. Lastly, after having pursued several hunters in vain, he singles out one, whom he sets upon with extreme fury. This man runs into the narrow alley, and the elephant follows him. But he no sooner enters than he perceives himself to be in a snare; for the man escapes, and two portcullises, one before and another behind, are instantly let fall; so that being unable either to advance or retreat the animal makes the most astonishing efforts, and raises the most hideous cries. The hunters endeavour to sooth him by throwing pails of water on his body, by rubbing him with leaves, by pouring oil upon his ears, and by bringing to him tamed elephants, both male and female, who caress him with their trunks. They fix ropes, however, round his body and hind legs, to enable them to drag him out, and they continue to throw water on his trunk and body in order to refresh him. In fine, a tamed elephant, accustomed to instruct noviciates, is made to approach him. The former is mounted by a servant, who makes the animal advance and retire, to show the wild elephant that he has nothing to fear and that he may go out. The port is then opened, and he follows his neighbour to the end of the alley. When there two elephants are tied, one to each side of him, another marches before, leads him in the way they want him to go, while a third pushes him behind with its head till they arrive at a kind of shade, where he is tied to a large post which turns round like the capstan of a ship. There he is left till next day, to allow his rage to subside. But while he frets around this post, a Bramin, one of those Indian priests who are extremely numerous in Siam, dressed in white, approaches the animal mounted on an elephant, turns gently round him, and bedews him with a consecrated water, which the priest carries in a golden vessel. They believe that by this ceremony the elephant loses his natural ferocity, and is rendered fit for the king's service. Next day he walks along with his enslaved neighbours; and at the end of fifteen days he is completely tamed.—*Premier Voyage du Pere Tachard.*

They had no sooner alighted from their horses, and mounted the elephants which were prepared for them, than the king appeared, accompanied with a great number of mandarins, riding on elephants of war. They all proceeded about a league into the wood, when they arrived at the place where the wild elephants were enclosed. This was a square park, of three or four hundred geometrical paces, the sides of wich were fenced with large stakes; in which, however, considerable openings were left at certain distances. It contained fourteen large elephants. As soon as the royal train arrived, a circle was formed, consisting of a hundred war elephants, which were placed round the park, to prevent the wild ones from forcing through the pallisades. We were stationed behind this fence near the king. A dozen of the strongest tame elephants were pushed into the park, each of them being mounted by two men, furnished large ropes and nooses, the ends of which were fixed to the elephants they rode. They first ran against the elephant they wished to seize, who seeing himself pursued endeavoured to force the barrier and make his escape. But the whole was blockaded by the war elephants, who pushed him back; and in his course the hunters, mounted on the tame elephants, threw their nooses so dexterously upon the spots where it behoved the animal to place his feet, that the whole were seized in the space of an hour. Each elephant was then bound with ropes, and two tame ones placed on each side of him, by means of which he is tamed in fifteen days.—*Idem.*

A few days after we had the pleasure of being present at the hunting of elephants. The Siamese are very dexterous at this species of hunting, which they have several modes of performing. The easiest, and not the least entertaining, is executed by means of female elephants. When a female is in season, she is conducted to the forest of Luovo. Her guide rides on her back, and covers himself with leaves, to prevent his being perceived by the wild elephants. The cries of the tame female, which she never fails to set up upon a certain signal given by the guide, collect all the elephants within the reach of hearing, who soon follow her. The guide, taking advantage of their mutual cries, returns slowly towards Luovo with all his train, and enters an inclosure made of large stakes, about a quarter of a league from the city, and pretty near the forest. A great troop of elephants were in this manner brought together, but one of them only was large, and it was very difficult to seize and to tame him. The guide who conducted the female went out of the enclosure by a narrow passage in the form of an alley, and about the length of an elephant. Each end of this alley was provided with a portcullis, which was easily raised or let down. All the young elephants followed the female at different times. But a passage so narrow alarmed the large one, who always drew back. The female was made to return

several times; he uniformly followed to the port; but, as if he foresaw his loss of liberty, he would never pass. Several Siamese, who were in the park, then advanced, and endeavored to force him by goading him with sharp pointed poles. The elephant, being enraged by this treatment, pursued them with such fury and quickness that not one of them would have escaped had they not nimbly retired behind the stakes of the pallisade, against which the ferocious creature broke its large tusks three or four times. In the heat of the pursuit, one of those who attacked him most briskly, and who was most keenly pursued, run into the alley, which the elephant entered in order to kill him. But the animal no sooner fell into the snare than the Siamese escaped by a small passage, and the two portcullises were instantly let down. The elephant struggled much; but he found himself obliged to remain in his prison. To appease him they threw pailfulls of water on his body. Ropes, however, were put round his legs and neck. After being fatigued for some time he was brought out by means of two tame elephants, who drew him forward with ropes, while other two pushed him behind till he was fixed to a large post, round which he could only turn. In an hour after he became so tractable that a Siamese mounted on his back; and next day he was let loose, and conducted to the stables along with the others.—*Second Voyage du P. Tachard.*

Though these animals be large and savage great numbers of them are taken in Æthiopia by the following stratagem: in the thickest parts of the forest, where the elephants retire during the night, an enclosure is made of stakes, interlaced with large branches, in which a small opening is left, which has a door lying flat on the ground. When the elephant enters, the hunters from the top of a tree draw up the door by means of a rope. They then descend and slay the animal with arrows. But if by accident they miss their aim, and the creature escapes from the enclosure, he kills every man he meets.—*L'Afrique de Marmol.*

There are different modes of hunting elephants. In some places caltrops are spread on the ground, by means of which the animals fall into ditches, from whence, after being properly entangled, they are easily drawn out. In others, a tame female is led into a narrow defile, and allures the male to approach by her cries. When he arrives the hunters shut him up by barriers, which they have in readiness for the purpose; and though he finds the female on her back, he copulates with her, contrary to the practice of other quadrupeds. After this he endeavours to retire. But while he goes about in quest of an outlet, the hunters, who are upon a wall, or some elevated situation, throw ropes and chains of different dimensions, by which they so entangle his trunk and the rest of his body, that they can approach him without danger; and after taking some necessary precautions they carry him off accompanied with two tame elephants, to show him a proper example, or to chastise him if he rebels. There are many other methods of hunting elephants; for every country has its own mode.—*Relation d'un Voyage, par Thevenot.*

The inhabitants of Ceylon dig pretty deep ditches, which they cover with thin planks and straw. During the night the elephants, having no suspicion of the deceit, come upon the planks and fall into the ditch, from which they are unable to escape, but would infallibly perish by hunger, if victuals were not brought to them by slaves, to whom they gradually become accustomed, and at last are rendered so tame, that they are brought to Goa, and other adjacent countries, to gain their own livelihood and that of their masters.—*Divers Memoires touchant les Indes Orientales.*

As the Europeans gave a high price for elephants' teeth, the love of gain arms the negroes perpetually against these animals. For this species of hunting they sometimes assemble in great bodies with their arrows and darts. But the most common and most successful method is that of digging ditches in the woods, because they are never deceived in distinguishing the track of the elephants. There are two methods of taking these animals, either by digging ditches and covering them with the branches of trees, into which the creatures inadvertently fall, or by hunting them, which is performed in the following manner. In the island of Ceylon, where the elephants are very numerous, the hunters keep female elephants, which they call *alias*. As soon as they learn that there are wild elephants in any place, they repair thither, accompanied with two of these alias, which, whenever a male is discovered, they let loose. The females come up on each side of him, and keeping him in the middle squeeze him so hard that he cannot escape.—*Voyage d'Orient*, &c.]

The elephant when tamed becomes the most gentle and most obedient of all domestic animals. He is so fond of his keeper, that he caresses him and anticipates his commands, by foreseeeing every thing that will please him. He soon learns to comprehend signs, and even to understand the expression of sounds. He distinguishes the tones of command, of anger, or of approbation, and regulates his actions accordingly. He never mistakes the voice of his master. He receives his orders with attention, executes them with prudence and eagerness, but without any degree of precipitation; for his movements are always measured, and his character seems to partake of the gravity of his mass. He easily learns to bend his knees for the accommodation of those who mount him. His friends he caresses with his trunk, salutes with it such people as are pointed out to him, uses it for raising burdens, and assists in loading

himself. He allows himself to be clothed, and seems to have a pleasure in being covered with gilded harness and brilliant housings. He is employed in drawing chariots, ploughs, waggons, &c. He draws equally, and never turns restive, provided he is not insulted with improper chastisement, and the people who labour with him have the air of being pleased with the manner in which he employs his strength.

[I was an eye-witness to the following facts. At Goa there are always some elephants employed in the building of ships. I one day went to the side of the river, near which a large ship was building in the city of Goa, where there is a large area filled with beams for that purpose. Some men tie the ends of the heaviest beams with a rope, which is handed to an elephant, who carries it to his mouth, and, after twisting it round his trunk, draws it without any conductor to the place where the ship is building, though it had only once been pointed out to him. He sometimes drew beams so large that more than twenty men would have been unable to move. But what surprised me still more, when other beams obstructed the road, he elevated the ends of his own beams, that they might run easily over those which lay in his way. Could the most enlightened man do more?—*Voyage d'Orient*, &c.]

The man who conducts the animal generally rides on his neck, and uses an iron rod hooked at the end, or a bodkin, with which he pricks the head or sides of the ears, in order to push the creature forward, or to make him turn. But words are generally sufficient, especially if the animal has had time to acquire a complete acquaintance with his conductor, and to put entire confidence in him. The attachment of the elephant becomes sometimes so strong, and his affection so warm and durable, that he has been known to die of sorrow when in a paroxysm of rage he had killed his guide.

Though the elephant produces but a single young one in two or three years the species is very numerous. The prolific powers of animals are proportioned to the shortness of their lives. In elephants the duration of life compensates their sterility; and if it be true that they live two centuries, and can propagate till they are one hundred and twenty years old, each couple may produce forty in this period. Besides, as they have nothing to fear from other animals, and are taken with much difficulty and hazard by men, the species is easily supported, and is generally diffused over all the southern regions of Africa and Asia. Elephants abound in Ceylon, in the Mogul empire, in Bengal, in Siam, in Pegu, and in all the other territories of India. They are perhaps still more numerous in all the southern regions of Africa, except certain cantons which they have abandoned, because they are totally occupied by men. Elephants are faithful to their country, and never change their climate; for though they can live in temperate regions, yet they appear not to have ever attempted to establish themselves, or even to travel into these climates. They were formerly unknown in Europe. Homer, though he mentions ivory, seems not to have been acquainted with the animal by which that substance is produced. Alexander the Great was the first European who ever mounted an elephant. Those which he took from Porus he caused to be brought to Greece; and they were perhaps the same which Pyrrhus several years after employed against the Romans in the Tarentine war, and with which Curius came triumphant into Rome. Annibal afterwards transported elephants from Africa, made them pass the Alps, and conducted them almost to the gates of Rome.

The Indians, from a period beyond the records of history, have employed elephants in war. Among these undisciplined nations the elephants formed their best troop; and as long as steel weapons alone were employed, they generally decided the fate of battles. We learn from history, however, that the Greeks and Romans were soon accustomed to these monsters of war. They opened their ranks to let them pass, and directed all their weapons, not against the animals, but their conductors, who used all their efforts to turn and appease those which had separated from the rest of the troop.

[From time immemorial the kings of Ceylon, of Pegu, and of Aracan, have used elephants in wars. Naked sabres were tied to their trunks, and on their backs were fixed small wooden castles, which contained five or six men armed with javelins and other weapons. They contribute greatly to disorder the enemy; but they are easily terrified by the sight of fire.—*Recueil des Voyages de la Compagnie des Indes.*]

Now that fire has become the element of war, and the chief instrument of death, elephants, which are terrified both at the noise and flame, would be more dangerous than useful in our combats. The Indian kings still arm elephants in their wars; but this practice is designed more for show than utility. One advantage, however, is derived from them. Like every other military order they serve the purpose of enslaving their equals, and are, accordingly, used in taming the wild elephants. The most powerful monarchs of India have not now above two hundred war elephants. They keep many others for the purposes of labour, and for transporting their women in large cages covered with foliage. It is a very safe mode of riding; for the elephant never stumbles: but to be accustomed to his brisk and swinging movements requires time and practice. The neck is the best seat; for there the succussions are not so hard as on the shoulders, back, or crupper. But for the purposes of war, or of hunting, each elephant is always mounted by several men. The conductor rides a-straddle on their neck, and the hunters or combatants sit on the other parts of the body.

[Few people in India have elephants. Even their

nobles have not many; and the Great Mogul keeps not above five hundred for his household, and for transporting his baggage and women, in wattled cages or baskets. I have been assured that he has not above two hundred war elephants, part of which are employed in carrying small pieces of artillery.—*Voyage de Thevenot.*]

In those happy regions where cannon and other murdering engines are imperfectly known they still fight with elephants. At Cochin, and other parts of Malabar, horses are not used, and all the warriors who fight not on foot are mounted on elephants. The practice is nearly the same in Tonquin, Siam, and Pegu, where the king and great lords always ride upon elephants. At festivals they are preceded and followed by a numerous train of these animals, pompously adorned with pieces of shining metal, and covered with rich stuffs. Their tusks are ornamented with rings of gold and silver; their ears and cheeks are painted; they are crowned with garlands; and a number of little bells are fixed to different parts of their body. They seem to delight in rich attire; for they are chearful and caressing in proportion to the number of their ornaments. But it is only in the southern parts of India where the elephants have acquired this degree of polish. In Africa it is with difficulty they can be tamed.

[We have seen elephants whose teeth were extremely large and beautiful. In some they are more than four feet long, and garnished with rings of gold, silver, and copper.—*Premier Voyage du P. Tachard.*

The grandeur of the princes consists in the number of elephants they are able to keep, which is the chief source of their expence. The Great Mogul has several thousands of them. The king of Madura, the lords of Narzinga and of Bisnagar, and the kings of Naires and of Mansul, have several hundreds, which they distinguish into three classes. The largest are destined for the service of the prince. Their harness is extremely rich. They are covered with cloth embroidered with gold, and studded with pearls. Their teeth are adorned with fine gold and silver, and sometimes with diamonds. Those of a middle size are employed in war; and the least are used for common labour.—*Voyage du P. Vincent Marie.*]

The Asiatics, who have been very anciently civilized, made the education of the elephant a kind of art, and have instructed and modified him according to their own manners. But of all the African nations the Carthaginians alone formerly trained the elephants to war; because at the splendid period of their republic they were perhaps the most civilized people of the east. There are now no wild elephants in all that part of Africa on this side of Mount Atlas. There are even few beyond these mountains till we arrive at the river Senegal. But they are numerous in Senegal, in Guinea, in Congo, on the Teeth coast, in the countries of Anta, Acra, Benin, and all the other southern territories of Africa, as far as those which are terminated by the Cape of Good Hope; except some well inhabited provinces, such as Fida, Ardra, &c. We even find them in Abyssinia, in Æthiopia, in Nigritia, upon the eastern coasts, and in all the interior parts of Africa. They likewise exist in the large islands of India and Africa, as Madagascar, Java, and as far as the Philippine Islands.

[The elephants, of which I daily saw great numbers along the banks of the river Senegal, no longer astonished me. On the fifth day of November I walked into the woods opposite to the village of Dagana, where I found a number of their fresh tracks, which I followed near two leagues, and at last discovered five of these animals; three of them lay wallowing, like hogs, in their own soil, and the fourth was standing with its cub, eating the branches of an acacia tree, which they had broken off. By comparing the animal with the height of the tree, I perceived that its crupper was at least eleven or twelve feet high, and its tusks near three feet long. Though my presence did not disturb them, I thought it proper to retire. In pursuing my route I met with the impressions of their feet, which measured near a foot and a half in diameter. Their dung, which resembled that of a horse, formed balls seven or eight inches in diameter.—*Voyage au Senegal,* &c.

The first country where elephants are frequent is that part of the coast called by the Flemish *Tand-kust,* or *Teeth-coast,* on account of the number of elephants' teeth, of which the natives make a lucrative traffic. Towards the gold coast, and in the countries of Awiné, Jaumoré, Eguira, Abercroé, Ancober, and Axim, many elephants are daily slain; and the more any country is desert and uninhabited, it is proportionably more frequented by elephants and other savage animals.—*Voyage de Guinee.*

The country of Anta likewise abounds in elephants; for many of them are not only killed on the main land, but they daily come down to the sea coast, and under our forts, from which our people descry them, and make great ravages upon them. From Anta to Acra very few are found, but in the places mentioned above, because the countries between Anta and Acra have been a long time tolerably peopled, except that of Fetu, which for five or six years has been almost deserted, and the elephants, for that reason, have taken it into their possession. On the coast of Acra vast numbers are annually slain; because in these districts there is much desert and uninhabited land. In the country of Benin, as well as on the Rio de Calbari, Camerones, and other adjacent rivers and countries, these animals are so numerous that it is difficult to conceive how the natives can or dare live in them.—*Idem.*

Below the Bay of St. Helen's the country is divided into two portions by the Elephant river, which has received its name from the elephants, who love running

waters and are found in great numbers upon their banks.—*Description du Cap. de Bonne Esperance.*

There are no elephants in Ardra, nor in Fida, though in my time one was killed there. But the Negroes affirm, that such an event had not happened for sixty years before. I therefore imagine that this animal had wandered thither from some other country.—*Voyage de Guinee.*]

After comparing the testimonies of travellers and historians, it appears that elephants are more numerous and common in Africa than in Asia. They are also less suspicious, and retire not to such distant solitudes. They seem to know the unskilfulness and debility of the men who inhabit this part of the world; for they daily approach the villages without discovering any apprehensions. They treat the Negroes with that natural and supercilious indifference which they entertain for all animals. They regard not man as a powerful or a formidable being, but as a crafty creature, who knows only how to lay snares in their way, but who dares not attack them face to face, and is ignorant of the art of reducing them to slavery. It is by this art alone, which has long been known in the eastern nations, that the number of these animals has been diminished. The wild elephants, which these people render domestic, become by captivity so many voluntary eunuchs, in whom the sources of generation are daily dried up. But in Africa, where the elephants are all free, the species is supported, and might even increase, though more of them were destroyed; because every individual is constantly labouring to repair the waste. I perceive no other cause to which this difference of number can be ascribed; for it appears, from every consideration, that the south of India and the east of Africa are the countries most congenial to the nature of the elephant. He is there much larger and stronger than in Guinea, or any other western region of Africa. He dreads excessive heat, and never inhabits the burning sands of the desert. Neither is the species so numerous in the country of the Negroes as along the rivers; and they are never found in the mountainous parts of Africa. But in India the strongest and most courageous of the species, and which have the largest tusks, are called *mountain elephants:* they inhabit the elevated parts of the country, where, the air being more temperate, the waters less impure, and the food more wholesome, they acquire all the perfections of which their nature is capable.

In general the elephants of Asia exceed in size, strength, &c. those of Africa; and those of Ceylon, in particular, are superior to all those of Asia, not only in magnitude, but in courage and intelligence. These qualities they perhaps derive from a more perfect education. However this may be, all travellers have celebrated the elephants of this island, where the surface of the earth is variegated with mountains, which are more elevated in proportion as they advance toward the centre of the island, and where the heat, though great, is not so excessive as in Senegal, Guinea, and the other western parts of Africa. The ancients, who knew nothing of this quarter of the world, except the territories situated between Mount Atlas and the Mediterranean, had remarked, that the Lybian elephants were much smaller than those of India. There are now no elephants in that part of Africa; which proves what was alledged under the article *lion*, that men are at present more numerous there than they were in the days of the Carthaginians. The elephants have retired in proportion to the disturbance they have met with from the human species. But in travelling through the climates of Africa they have not changed their nature; for the elephants of Senegal, Guinea, &c. are still much smaller than those of India.

The strength of these animals is proportioned to their magnitude. The Indian elephants carry with ease three or four thousand weight: the smaller, or those of Africa, can easily raise with their trunk a weight of two hundred pounds, and place it on their own shoulders. They draw up into their trunks large quantities of water, which they squirt into the air, or all around, to the distance of several fathoms. They can carry a weight of above a thousand pounds on their tusks. They use their trunk for breaking branches, and their tusks for tearing up trees. The greatness of their strength may be still farther conceived from the quickness of their movements, compared with the magnitude of their bodies. At their ordinary step they cut as much ground as a horse at a gentle trot; and they run as fast as a horse can gallop: but in a state of liberty they never run unless when enraged or terrified. Domestic elephants are generally walked, and they perform easily, without fatigue, a journey of fifteen or twenty leagues in a day; and when pushed they can travel thirty or forty leagues a-day. Their tread is heard at a great distance, and they may be easily followed by the tracks of their feet, which, in soft ground, measure fifteen or eighteen inches in diameter.

A domestic elephant performs more work than perhaps six horses; but he requires from his master much care and a great deal of good victuals, which cost about four francs, or a hundred pence a-day. He is generally fed with rice, raw or boiled, and mixed with water. To keep him in full vigour, he is said to require daily a hundred pounds of rice, besides fresh herbage to cool him; for he is subject to be overheated, and must be led to the water twice or thrice a-day for the benefit of bathing. He easily learns to bathe himself. He takes the water up in his trunk, carries it to his mouth, drinks part of it, and by elevating his trunk allows the remainder to run over every part of his body.

[The price of elephants is very high. They are some-

times sold from a thousand pagodas of gold to fifteen thousand rupees, that is, from nine or ten thousand livres to thirty thousand.—*Notes de M. de Bussy.*

At Ceylon an elephant is worth at least eight thousand *pardaons;* and when very large, he brings twelve, and even fifteen thousand pardaons.—*Histoire de l'Isle de Ceylon.*

The food of an elephant costs about half a pistole each day.—*Relation d'un Voyage, par Thevenot.*

Tamed elephants are very delicate in their feeding. They require rice well boiled, and seasoned with butter and sugar, which is given to them in large balls. They devour daily a hundred pounds of rice, besides leaves of trees, particularly those of the Indian fig, called *bananas* or *plantane*, which are given them by way of refreshment.—*Voyage de Pyrard.*]

To give an idea of the labour he performs, it is sufficient to remark, that all the tuns, sacks, and bales, transported from one place to another in India, are carried by elephants; that they carry burdens on their bodies, their necks, their tusks, and even in their mouths, by giving them the end of a rope, which they hold fast with their teeth; that, uniting sagacity to strength, they never break or injure any thing committed to their charge; that from the margins of the waters they put these bundles into boats without wetting them, laying them down gently, and arranging them where they ought to be placed; that when disposed in the places where their masters direct, they try with their trunk whether the goods are properly stowed; and if a tun or cask rolls, they go of their own accord in quest of stones to prop and render it firm.

When the elephant is properly managed, though in captivity, he lives a long time; and it is probable, that in a state of liberty his life is still longer. Some authors affirm, that he lives four or five hundred years, others two or three hundred, and others a hundred and twenty, a hundred and thirty, and a hundred and forty. I believe, that a medium between the two extremes is the truth; and that if captive elephants live a hundred and twenty, or a hundred and thirty years, those which are free, and enjoy all the conveniences and rights of nature, ought to exist at least two hundred. Besides, if they go two years with young, and require thirty before they obtain their full growth, we may, with still more certainty, conclude, that their life extends beyond the period we have affixed. But captivity abridges their existence less than the injuries arising from change of climate. Whatever care is bestowed on him the elephant lives not long in temperate, and still shorter in cold countries. That which the king of Portugal sent to Louis XIV. in 1668, and which was then only four years old, died in the month of January 1681, at the age of seventeen, and lived at Versailles only thirteen years, though he was fed plentifully, and managed with the greatest attention. He had daily eighty pounds of bread, twelve pints of wine, and two pails of pottage, mixed with four or five pounds of bread; and every second day, in place of pottage, he had two pails of boiled rice, without reckoning what was given him by visitors. He had, besides, a sheaf of corn every day for his amusement; for after eating the ears he made a kind of whip of the straw, with which he drove away the flies. He delighted in breaking the straw into small morsels, which he did very dexterously with his trunk; and as he was daily led out to walk, he pulled and eat the grass. The elephant which was lately at Naples, though the heat is greater there than in France, lived but a few years. Those which were sent to Petersburg, though well sheltered, clothed, and warmed with stoves, all died successively. Hence we may conclude, that this animal is incapable of subsisting, and far less can he multiply, in any part of Europe. But I am astonished that the Portuguese, who first knew the value and utility of elephants in the East Indies, did not transport them to the warm climate of Brasil, where, by leaving them at liberty, they would probably have multiplied. The elephants are generally ash-coloured or blackish. White elephants, as formerly remarked, are extremely rare; and authors are quoted who have seen white and red elephants in different parts of India, where they are highly valued.

[Some persons who lived long in Pondicherry seem to doubt the existence of white and red elephants; for they affirm, that in this part of India, at least, the elephants are all black. It is true, they remark, that when these animals are long neglected to be washed, the dust which adheres to their oily and naked skin gives them the appearance of a dirty gray colour; but when washed with water they become as black as formerly. I believe that black is the natural colour of elephants, and none of any other colour are to be found in those parts of India which these people have had an opportunity of seeing. But at the same time it seems not to admit of a doubt, that in Ceylon, Siam, Pegu, Cambaya, &c. some white and red elephants are accidentally to be met with. For ocular witnesses of this fact we might quote the Chevalier Chaumont, l'Abbé de Choisy, le P. Tachard, Vander Hagen, Joost Schuten, Thevenot, Ogilvy, and other travellers of less note. Hortensels, who has collected in his *Elephantographia* a great number of facts from different voyagers, assures us, that the white elephant has not only a white skin, but that the hair of its tail is also white. To these testimonies we might add the authority of the ancients. Ælian mentions a small white elephant in India, and seems to insinuate that the mother was black. This variety in the colour of elephants, though rare, is certain, and very ancient. It has perhaps proceeded from their domestic condition, to which the Indians have been long accustomed to reduce these animals.

In the procession of the king of Pegu two red elephants are led before, harnessed with silk and gold stuffs, which are followed by four white elephants, harnessed in a similar manner, with the addition of precious stones, and the tusks covered with rubies.—*Voyage de la Compagnie des Indes d'Hollande.*]

Besides, these varieties are so uncommon, that instead of considering them as distinct races, they ought to be regarded as qualities purely individual and accidental; for if it were otherwise, we should know the countries of white, red, and black elephants, in the same manner as we know the climates of white, red, and black men. 'In India,' says P. Vincent Marie, 'there are three 'kinds of elephants, the white, which are the largest, 'the most gentle, and peaceable, are adored as gods by 'several nations: the red, such as those of Ceylon, 'though the smallest in size, are the most valorous, the 'strongest, and the best for the purposes of war; the 'other elephants, whether from natural inclination, or 'from recognising something superior, pay great respect 'to those of Ceylon: the black is the third kind, and they 'are the most common, and in most estimation.' This is the only author who seems to hint, that Ceylon is the peculiar climate of red elephants; for other travellers make no mention of such a fact. He likewise asserts, that the Ceylon elephants are the smallest. Thevenot says the same thing in his voyage. But other writers relate the reverse. In fine, P. Vincent is the only author who says, that the white elephants are the largest. P. Tachard, on the contrary, assures us, that the king of Siam's white elephant was diminutive, though very old. After comparing the testimony of travellers with regard to the magnitude of elephants in different climates, it appears, that the smallest are those of the west and north of Africa, and that the ancients, who knew only the northern part of Africa, were right in their general assertion, that the Indian elephants were much larger than those of Africa. But in the eastern regions of this quarter of the world, of which the ancients were ignorant, the elephants are as large, and perhaps larger than those of India. In this last region, it appears, that the elephants of Siam, Pegu, &c. are larger than those of Ceylon; which, however, from the unanimous testimony of travellers, have more courage and intelligence.

Having thus marked the principal facts with regard to the species, let us next examine in detail the properties of the individual, his senses, movement, size, strength, address, sagacity, &c. In proportion to the magnitude of his body the eyes of the elephant are very small; but they are lively and brilliant: what distinguishes them from the eyes of all other animals is a pathetic expression of sentiment, and an almost rational management of all their actions. He turns them slowly and with mildness towards his master. When he speaks the animal regards him with an eye of friendship and attention, and his penetrating aspect is conspicuous when he wants to anticipate the inclination of his governor. He seems to reflect, to deliberate, to think, and never determines till he has several times examined without passion or precipitation the signs which he ought to obey. The dog, whose eyes are very expressive, is too prompt and vivacious to allow us to distinguish with ease the successive shades of his sensations. But as the elephant is naturally grave and moderate, we read in his eyes, whose movements are slow, the order and succession of his internal affections.

His ear is very good; and the external organ of hearing, like that of smelling, is more remarkable in the elephant than in any other animal. His ears are very large, and much longer, even in proportion to his body, than those of the ass. They lie flat on the head, like the human ears. They are commonly pendulous; but he can raise and move them with such facility, that he uses them to defend his eyes from dust and flies. He delights in the sound of musical instruments, and moves in cadence to the trumpet and tabour. His sense of smelling is exquisite, and he is passionately fond of perfumes of every kind, and especially of odoriferous flowers, which he gathers one by one, makes nosegays of them, and after gratifying his nose conveys them to his mouth. The flowers of the orange constitute one of his most delicious morsels. With his trunk he robs an orange tree of all its verdure, eating the fruit, the flowers, the leaves, and even the small branches. In the meadows he selects the most odoriferous plants; and in the woods he prefers the cocoa, the banana, the palm, and the sago trees; and as these trees are soft and tender, he eats not only the leaves and fruit, but even the branches, the trunk, and the roots; for when they are unable to pull up the trees with their trunk, they always succeed by using their tusks.

With regard to the sense of touching it is chiefly confined to the trunk; but in this member it is as delicate and distinct as in the human hand. The trunk is composed of membranes, nerves, and muscles; it is both an organ of feeling and of motion. The animal can not only move and bend it, but he can contract, lengthen, and turn it on all sides. The extremity of the trunk terminates in a protuberance, which stretches out on the upper side in the form of a finger, by means of which the elephant performs all that we do with our fingers. He lifts from the ground the smallest piece of money; he selects the herbs and flowers, and picks them up one by one; he unties the knots of ropes, opens and shuts gates, by turning the keys, or pushing back the bolts. He learns to trace regular characters with an instrument as small as a quill. It cannot be denied that the elephant's hand has several advantages over ours. It is equally flexible, and as dexterous in

touching or laying hold of objects. These operations are performed by means of the appendix or finger, situated on the superior part of the border that surrounds the extremity of the trunk, in the middle of which there is a concavity in the form of a cup, and in the bottom of the cup are the apertures of the two common canals of smelling and of respiration. The elephant therefore has his nose in his hand, and is enabled to combine the power of his lungs with the action of his fingers, and to attract fluids by a strong suction, or to raise heavy bodies by applying to them the edge of his trunk, and making a vacuum within by a vigorous inspiration.

Hence delicacy of feeling, acuteness of smelling, facility of movement, and the power of suction, are united at the extremity of the elephant's nose. Of all the instruments which nature has so liberally bestowed on her most favourite productions, the trunk of the elephant is perhaps the most complete and the most admirable. It is not only an organic instrument, but a triple sense, whose united functions are at once the cause, and produce the effects of that sagacity and those remarkable talents which distinguish the elephant, and exalt him above all other quadrupeds. He is not so subject, as other animals, to errors of vision; because he quickly rectifies them by the sense of touching; and by using his trunk, as a long arm, for the purpose of touching remote objects, he acquires, like man, clear ideas of distances. But the other animals, except the monkeys, and some others, who have a kind of arms and hands, cannot acquire ideas of distance but by traversing space with their bodies. Of all the senses, that of touching has the greatest relation to intelligence. The delicacy of touching, the flexibility of the trunk, the power of suction, the sense of smelling, and the length of the arm, give the ideas of the substance of bodies, of their external form, of their weight, of their salutary or noxious qualities, and of their distance. Thus, by the same members, and by one simultaneous act, the elephant feels, perceives, and judges of several things at one time. Now a multiplied sensation is equivalent, in some measure, to reflection; though this animal therefore is, like all others, deprived of the faculty of reflecting, as his sensations are combined in the same organ, contemporary, and not separated from each other, it is not surprising that he should have ideas of his own, and readily acquire those we wish to communicate to him. The memory of the elephant should be more perfect than that of any other animal; for memory depends greatly on the circumstances of actions. No solitary sensation, however lively, can leave any distinct or durable impression; but several combined and contemporary sensations make deep and lasting impressions; so that if the elephant cannot recollect an idea by touch alone, the adjacent and accessory sensations of smelling, and the power of suction, which have acted at the same time, aid him in recalling the remembrance of it. In man the best mode of rendering the memory faithful is to employ successively all our senses in examining an object; and it is owing to the neglect of habituating ourselves to the combined use of our senses that we forget most things we ought to remember.

But though the elephant has more memory and intelligence than any other animal, his brain is proportionably smaller than that of most quadrupeds. I mention this fact as a proof that the brain is not the seat of sensation, the *sensorium commune*, which, on the contrary, resides in the nerves of the senses, and in the membranes of the head. Thus the nerves distributed upon the trunk of the elephant are so numerous as to be equivalent to all those bestowed on the rest of the body. It is, therefore, by virtue of this singular combination of senses and faculties in the trunk, that the elephant excels all other animals in sagacity, notwithstanding the enormity of his mass, and the disproportion of his form; for the elephant is, at the same time, a miracle of intelligence and a monster of matter. The thickness and inflexibility of his body, the shortness and stiffness of his neck; the smallness and deformity of his head, the excessive largeness of his ears and nose, the minuteness of his eyes, mouth, genitals, and tail; his straight, clumsy, and almost inflexible limbs, the shortness and smallness of his feet, which are hardly apparent; the thickness and callosity of his skin: all these deformities are the more conspicuous and disagreeable to the eye, because they are modelled on a large scale, and most of them peculiar to the elephant alone; for in no animal are the head, the feet, the nose, the ears, and the tusks, situated like those of the elephant.

From this strange conformation the animal is subjected to several inconveniencies. He moves his head with difficulty, and cannot turn himself in order to go back without making a circuit. The hunters who attack him behind, or on the flanks, avoid the effects of his vengeance by circular movements; and they have time to renew their blows while he is turning himself against them. His legs, the rigidity of which is not so great as that of his neck and body, bend but slowly, and with difficulty. They are strongly articulated to the thighs. His knee is like that of a man, and his foot is equally low; but the latter has no extent, spring, or force, and the former is hard and rigid. As long, however, as the elephant is young and in health, he bends his knees to lie down, and allows himself to be mounted or charged with a load. But when old or sick this movement becomes so laborious that he chooses rather to sleep on his feet; and if forced to lie down machines are necessary to raise him. His tusks, which with age become enormously heavy, and not being placed, like the horns of other animals, in a vertical position, form two long

levers, which, by their almost horizontal direction fatigue the head prodigiously, and make it hang down; so that the animal is sometimes obliged to make holes in the wall of his lodge to support them, and relieve him of their weight.

[We learned from the people who had the charge of the elephant at Versailles, formerly mentioned, that the first eight years he lived he lay down and rose with great facility; and that during the last five years he did not lie down to sleep, but leaned against the wall of his apartment; so that if he had happened to lie down when sick, it would have been necessary to pierce the floor above, in order to raise him with engines.—*Mem. pour servir a l'Histoire des Animaux.*

We saw where the elephant had employed his tusks in making holes in a stone pillar, which projected from the wall of his lodge, and these holes supported him when sleeping, his tusks being put into them.—*Idem.*]

He has the disadvantage of having the organ of smelling very distant from that of tasting, and the inconvenience of not being able to seize any thing on the ground with his mouth, because his neck is too stiff and too short to allow his head to reach the earth. He is therefore obliged to lay hold of his food, and even of his drink, with his nose, and then to convey it, not only to the entrance of his mouth, but as far as his throat; and when the trunk is filled with water, he thrusts the end of it to the very root of the tongue, seemingly with the intention of pushing back the epiglottis to prevent the water, which rushes out with impetuosity, from entering into the larynx; for he forces out the water by the same air which he employed to suck it up, and it rushes out of the trunk with noise, and precipitantly enters the gullet. The tongue, the mouth, and the lips, are of no use to him, as in other animals, to suck or lap his drink.

From this description the singular consequence results, that the young elephant must suck with its nose, and afterwards convey the milk to its gullet. We are told, however, by the ancients, that he sucks with his mouth, and not with his trunk. But there is reason to believe that they never were witnesses of the fact, and that they reasoned solely from the analogy of other animals. If the young elephant ever acquired the habit of sucking with its mouth, why should he lose it during the rest of his life? Why does he never employ the mouth to suck in water? Why does he uniformly employ a double action, when a single one would answer the purpose? Why does he never seize any object with his mouth, except what is thrown into it when open? It is therefore extremely probable, that the young elephant sucks with his trunk only. This presumption is not only proved by the following facts, but is founded on a stronger analogy than that which gave rise to the opinion of the ancients. We formerly remarked, that in general animals at the moment of birth can perceive the presence of the aliment they want by no other sense but that of smelling. The ear can have no effect; neither can the eye; for most animals are blind when they begin to suck. The sense of touching can only convey a vague and indiscriminate notion of all the parts of the mother's body, or rather it can indicate nothing relative to appetite. But the sense of smelling is alone sufficient for this purpose: it is not only a species of taste, but a foretaste, which precedes, accompanies, and determines the other kind. The elephant, therefore, like all other animals, perceives by this foretaste the presence of his aliment; and as the seat of smelling is united with the power of suction at the extremity of the trunk, he applies it to the teat, sucks the milk, and conveys it to the mouth to satisfy his appetite. Besides, the two paps, as in woman, are situated on the breast, and the teats being very small in proportion to the size of the young one's mouth, whose neck also has little flexibility, the mother must have lain on her back or side to enable her young to lay hold of the teat with its mouth; and even in this situation it would have been difficult to extract the milk, on account of the enormous disproportion between the largeness of the mouth and the smallness of the teat. But the margin of the trunk, which the animal contracts at pleasure, is easily accommodated to the teat, and enables the young elephant to suck the mother either when she stands or lies on her side. Thus every circumstance concurs in invalidating the notion of the ancients on this subject; for none of them, nor even any of the moderns, alledge that they ever saw the elephant sucking; and I have no hesitation in predicting, that whenever such an observation is made, it will appear that he sucks not with his mouth but with his nose. I likewise imagine that the ancients are deceived when they tell us that the elephants copulate like other quadrupeds, the female only lowering her crupper for the more easy reception of the male. The situation of the parts seems to render this mode of junction impossible. The female elephant has not, like other quadrupeds, the orifice of the vagina adjacent to the anus; for it is situated nearly in the middle of the belly, about two and a half or three feet distant from the anus. On the other hand, the male organ is by no means proportioned to the magnitude of his body, nor to so long an interval, which, in the situation supposed, would preclude the practicability of his approach. Naturalists, as well as travellers, agree in affirming, that the male organ of the elephant exceeds not, either in length or diameter, that of a horse. It is, therefore, impossible that he should attain his end in the ordinary position of quadrupeds. The female must necessarily lie on her back. De Feynes and Travernier positively assert, and the situation of the parts confirms their evidence, that these animals cannot intermix in any other manner.

They require, therefore, more time and conveniency for this operation than other quadrupeds; and it is perhaps for this reason that they never copulate but when they enjoy full liberty, and have every necessary article at their command. The female must not only consent, but solicit the male by a position which she never assumes unless when she thinks herself in perfect retirement. May we not therefore conclude, that modesty is a physical virtue which exists in the brute creation? It is at least like softness, moderation, and temperance, a general and beautiful attribute of the female sex.

[When these animals couple the female lies on her back; and after the operation, the male raises the female with his trunk.—*Voyage par Terre a la Chine*, &c.

Though the elephants have no intercourse in a domestic state; yet they frequently come in season. It is remarkable, that the female on these occasions collects all kinds of herbs and leaves, of which she makes a bed elevated four or five feet above the ground, and, contrary to the nature of all other quadrupeds, lies down on her back, and solicits the male by her cries.—*Voyage de Tavernier.*

The elephants copulate in a singular manner. The female lies down on her back. The male rests on his fore legs, bends down those behind, and touches not the female any farther than is necessary to effect his purpose.—*M. de Bussy's Notes.*

The elephants couple very rarely; and when they do it is with such secrecy, and in places so solitary, that they have never been observed by any person. When in a domestic state they never produce.—*Voyage aux Indes Orientales.*]

Thus the elephant neither sucks, generates, eats, nor drinks, like other animals. The sound of his voice is likewise extremely singular. If we believe the ancients, the elephant utters two kinds of cries, one by the trunk, which from its sinuosities and inflexions is rough and long, like the sound of a trumpet; and another by the mouth, which is interrupted by short pauses and harsh sighs. This fact, which was advanced by Aristotle, and afterwards repeated by naturalists and travellers, is probably false, or at least not exactly related. M. de Bussy denies that the elephant utters any cry through the trunk. However, as a man by shutting his mouth close can make a sound through his nose, the elephant, whose nose is so large, may produce sounds in the same manner. But however this may be, the cry of the elephant is heard at the distance of more than a league, and yet it excites not terror, like the roaring of the lion or tiger.

The elephant is still more singular in the structure of his feet and the texture of his skin, which last is not, like other quadrupeds, covered with hair, but totally bare, as if it were shaven. There are only a few bristles in the fissures of the skin, and these bristles are thinly scattered over the body, but very numerous on the cilia and back of the head, in the auditory passages, and the insides of the thighs and legs. In the epidermis, or scarf skin, there are two kinds of wrinkles, the one raised and the other depressed, which give it the appearance of being cut into fissures, resembling pretty nearly the bark of an old oak tree. In man, and the other animals, the epidermis adheres throughout to the skin; but in the elephant it is only attached by some points of insertion, like two pieces of cloth stitched together. This epidermis is naturally dry, and very subject to grow thick. It often acquires the thickness of three or four lines, by the successive drying of different layers which are produced one above another. It is this thickening of the scarf skin which gives rise to the *elephantiasis* or *dry leprosy*, to which man, whose skin is naked like that of the elephant, is sometimes subject. This disease is very common to the elephant; and the Indians, to prevent it, rub him frequently with oil, and bathe him with water, with a view to preserve the skin clean and flexible. The skin, where it is not callous, is extremely sensible. In the fissures, and other places where it is neither dry nor hardened, the elephant feels the stinging of flies in such a lively manner, that he not only employs his natural movements, but even the resources of his intelligence to get rid of them. He strikes them with his tail, his ears, and his trunk. He contracts his skin, and crushes them between its wrinkles. He drives them off with branches of trees or handfuls of long straw. When all these artifices are unsuccessful he collects dust with his trunk, and covers all the sensible parts of his skin with it. He has been observed pulverising himself in this manner several times in a day; and always at the most proper season, namely, after bathing. The use of water is as necessary to these animals as air. When free they never quit the banks of rivers, and often go into the water till it reaches their belly, and in this situation they daily spend several hours. In India, where the elephants are treated in the manner that best corresponds with their nature and temperament, they are carefully bathed, and allowed time and every possible conveniency for bathing themselves. Their skin is cleaned by rubbing it with a pumice stone; and then they are anointed with perfumed oils, and painted with various colours.

[I was informed that the elephant at Versailles always rolled in the dust after bathing, which he did as often as he was allowed; and it was observed that he threw dust upon all the places which had been missed when he rolled himself, and that he drove off the flies with handfuls of straw, or by throwing dust with his trunk on the places where he felt himself stung, there being

nothing which the flies avoid so much as falling dust.—*Mem. pour servir a l'Histoire des Animaux.*

About eight or nine o'clock before noon we went to the river to see the elephants belonging to the king and the nobles bathed. The animal goes into the water till it reaches his belly, and lying down on one side fills his trunk several times, and throws the water upon the parts which are uncovered. The master then rubs off with a kind of pumice stone all the dirt that has been collected on the creature's skin. Some authors tell us, that when the elephant lies down he is unable to raise himself. But this assertion is not founded in truth; for the master, after rubbing on one side, desires the animal to turn to the other, which he does very quickly; and after both sides are well curried, he comes out of the river, and stands some time on the bank till he dries. The master then brings a pot of red or yellow paint, and draws lines on the elephant's face round the eyes, and upon the breast and rump. He is next rubbed over with oil to strengthen his nerves.—*Voyage de Tavernier.*]

The structure of the elephant's feet and legs still differs from that of most other animals. The fore legs appear to be longer than the hind legs, and yet the former are somewhat shorter. The hind legs are not bended in two places like those of the horse and ox, in whom the thigh-bone is almost totally concealed in the buttock, the knee is situated near the belly, and the bones of the foot are so high and so long, that they appear to constitute a great part of the leg. But the foot of the elephant is very short, and rests on the ground. His knee, like that of a man, is placed near the middle of the leg. The short foot of the elephant is divided into five toes, which are so covered with the skin as not to be visible. We only see a kind of nails, the number of which varies, though that of the toes remains always the same. There are uniformly five toes on each foot, and commonly five nails; but sometimes there are only four, or even three nails; and in this case they correspond not exactly with the extremities of the toes. Besides, this variety, which has only been remarked in young elephants brought to Europe, seems to be purely accidental, and probably depends on the manner the animal has been treated during the first years of its growth. The sole of the foot is covered with a kind of leather as hard as horn, and projects outward all around. The nails consist of the same substance.

The ears of the elephant are very long, moveable at pleasure, and serve the animal as a fan. The tail is not longer than the ears, being generally from two and a half to three feet in length. It is thin, pointed, and garnished at the extremity with a tuft of thick hairs, or rather threads of a black, glossy, solid, horny substance. This hair or horn is as thick and strong as iron-wire, and a man cannot break it by pulling it with his hands, though it be flexible and elastic. In fine, this tuft of hair is greatly esteemed as an ornament by the Negro women, who are probably attached to it by some superstition. An elephant's tail is sometimes sold for two or three slaves; and the Negroes often hazard their lives in endeavouring to cut it off from the live animal. Beside this tuft, the tail is covered, or rather strewed, through its whole extent, with bristles as large and as hard as those of the wild boar. These bristles are also found on the convex part of the trunk and the eye-brows, where they sometimes exceed a foot in length. Bristles or hairs on the eye-lids are peculiar to man, the monkey and the elephant.

[Merolla remarks, that many of the Pagans in these countries, and particularly the Saggas, have a devout regard for the elephant's tail. When any of their chiefs die, they preserve, in honour of him, one of these tails, to which they pay a kind of religious worship, founded on the notion of its power. They often go a hunting solely with a view to obtain a tail of this kind. But it must be cut off with a single blow from the live animal, without which superstition allows it no virtue.—*Histoire Gen. des Voyages.*]

Climate, food, and situation, have a great influence on the growth and size of the elephant. In general, those that are taken young, and reduced to captivity, never acquire their natural dimensions. The largest elephants of India and the eastern parts of Africa are fourteen feet high; the smallest, which are found in Senegal and other western regions of Africa, exceed not ten or eleven feet; and those which are brought to Europe when young never arrive at this height. The Versailles elephant, which came from Congo, at the age of seven years, was not above seven and a half feet high. During the thirteen years that he lived he acquired only one foot; so that, at the age of four, when he was transported, he was only six and a half feet in height; and as the rate of growth always diminishes as animals advance in years, it cannot be supposed, that if he had lived thirty years, the common period when the growth of elephants is completed, he would have acquired more than eight feet in height. Hence the domestic state reduces the growth of the elephant one third, not only in height, but in all other dimensions. The length of his body, from the eye to the origin of the tail, is nearly equal to his height at the withers. An Indian elephant, therefore, of fourteen feet high, is more than seven times larger and heavier than the Versailles elephant. By comparing the growth of this animal to that of man, we shall find, that an infant, being commonly thirty-one inches high, that is, one half of its height, at the age of two years, and taking its full growth at twenty years, the elephant, which grows till thirty, ought to acquire the half of his height in three years. In the same manner, if we would form a judgment of the enormous mass of the elephant, we shall find, that the volume of a man's

body being supposed to be two cubic feet and a half, the body of an elephant of fourteen feet long, three feet thick, and a proportional breadth, would be fifty times as large; and, consequently, that an elephant ought to weigh as much as fifty men.

[Peirere, in his life of Gassendi, says, that an elephant, which he caused to be weighed, was three thousand five hundred pounds. This elephant seems to have been very small; for, according to the calculation I have made, the dimensions of which I rather under-rated, he would have weighed at least eight thousand pounds.]

'I saw,' says le P. Vincent Marie, 'some elephants 'which were fourteen and fifteen feet high, [probably 'Roman feet,] with a proportional length and thickness. 'The male is always larger than the female. The price 'of these animals augments in proportion to their size, 'which is measured from the eye to the extremity of 'the back, and, after exceeding certain dimensions, the 'price rises like that of precious stones.'

'The Guinea elephants,' Bosman remarks, 'are ten, 'twelve, or thirteen feet high [probably Rhenish feet]; 'and yet they are incomparably smaller than those of the 'East Indies; for the historians of that country give more 'cubits to the height of the latter than the former has 'feet.'

'I saw,' says Edward Terry, 'elephants of thirteen 'feet in height, and many people affirmed, that they had 'seen elephants fifteen feet high.'

From these, and many other authorities which might be enumerated, we may conclude, that the ordinary stature of the elephant is from ten to eleven feet; that those of thirteen and fourteen are very rare; and that the smallest, when they acquire their full growth in a state of liberty, are at least nine feet. These enormous masses of matter fail not, however, as formerly remarked, to move with great quickness. They are supported by four members, which, instead of legs, resemble massy columns of fifteen or eighteen inches diameter, and from five to six feet high. These legs, therefore, are twice as long as those of a man. Hence, though the elephant should make but one step while a man makes two it would outstrip him in the chace. The ordinary walk of the elephant is not quicker than that of a horse; but when pushed he assumes a kind of amble, which, in fleetness, is equivalent to a gallop. He performs with promptness, and even with freedom, all direct movements; but he wants facility in oblique or retrograde motions. It is generally in narrow and hollow places, where the elephant can hardly turn, that the negroes attack him, and cut off his tail, which they value above all the rest of the body. He has great difficulty in descending steep declivities, and is obliged to fold his hind legs, that in going down the anterior part of his body may be on a level with the posterior, and to prevent being precipitated by his own weight. He swims well, though the form of his legs and feet seem to indicate the contrary. But as the capacity of his breast and belly is large, as the size of his lungs and intestines is enormous, and as all the great parts of his body are filled with air, or matters lighter than water, he sinks not so deep as other animals. He has, therefore, less resistance to overcome, and, consequently, is enabled to swim more quickly with smaller efforts of his limbs. Of course he is of great use in the passage of rivers. When employed on these occasions, beside two pieces of cannon, which admit three or four pound balls, he is loaded with great quantities of baggage, independent of a number of men fixed to his ears and his tail. When thus loaded he enters the river, and swims so much below the water that no part of his body is seen except his trunk, which he raises in the air for the benefit of respiration.

Though the elephant generally feeds on herbs and tender wood, and though prodigious quantities of this aliment are necessary to afford a sufficient number of organic particles to nourish so vast a body, he has not several stomachs, like most animals who live on the same substances. He has but one stomach, does not ruminate, is formed rather like the horse than the ox and other ruminating animals. The want of a paunch is supplied by the largeness and length of his intestines, and particularly of the colon, which is two or three feet in diameter, by fifteen or twenty in length. The stomach is much smaller than the colon, being only three and a half or four feet long, and only one or one and a half in its largest diameter. To fill such capacious vessels, it is necessary that the animal, when not furnished with nourishment more substantial than herbage, should eat almost perpetually. Wild elephants, accordingly, are almost continually employed tearing up trees, gathering leaves, and breaking young wood; and the domestic elephants, though supplied with great quantities of rice, fail not to collect herbs whenever they have an opportunity. However great the appetite of the elephant he eats with moderation, and his taste for cleanliness is superior to the calls of hunger. His address in separating with his trunk the good leaves from the bad, and the care which he takes in shaking them till they are perfectly clear of insects and sand, afford great pleasure to the spectator. He is fond of wine, aquavitæ, arrack, &c. By showing him a vessel filled with any of these liquors, and promising him it as the reward of his labours, he is induced to exert the greatest efforts, and to perform the most painful tasks. He seems to love the smoke of tobacco; but it stupifies and intoxicates him. He abhors all bad smells; and has such a terror at the hog, that the cry of that animal makes him fly.

[The Versailles elephant had such a terror and aversion at swine, that the cry of a young hog made him fly to a great distance. This antipathy has been remarked by Ælian.]

To complete the idea of the nature and intelligence of this singular animal, I shall here add some notes communicated to me by the Marquis de Montmirail, president of the Royal Academy of Sciences, who has been so obliging as not only to collect, but to translate every thing regarding quadrupeds from some Italian and German books with which I am unacquainted. His zeal for the advancement of knowledge, his exquisite discernment, and his extensive knowledge in natural history, entitle him to the highest marks of distinction; and the reader will find how often I shall have occasion to quote him in the subsequent parts of this work. 'The 'elephant is used in dragging artillery over mountains, 'and it is on such occasions that his sagacity is conspi- 'cuous. When the oxen yoked to a cannon make an 'effort to pull it up a declivity, the elephant pushes the 'breach with his front, and at each effort he supports 'the carriage with his knee, which he places against the 'wheel. He seems to understand what is said to him. 'When his conductor wants him to execute any painful 'labour, he explains the nature of the operation, and 'recites the reasons which ought to induce him to obey. 'If the elephant shows a repugnance to what is exacted 'of him, the *cornack*, which is the name of the con- 'ductor, promises to give him arrack or some other 'thing that he likes. But it is extremely dangerous to 'break any promise that is made to him: many cornacks 'have fallen victims to indiscretions of this kind. On 'this subject a fact, which happened at Decan, deserves 'to be related, and though it has the appearance of in- 'credibility, it is notwithstanding perfectly true. An 'elephant out of revenge killed his cornack. The man's 'wife, who beheld the dreadful scene, took her two 'infants and threw them at the feet of the enraged ani- 'mal, saying, *Since you have slain my husband, take my 'life also, as well as that of my children.* The elephant 'instantly stopped, relented, and, as if stung with re- 'morse, took the eldest boy in its trunk, placed him on 'its neck, adopted him for its cornack, and would never 'allow any other person to mount it.

'If the elephant is vindictive he is not ungrateful. 'A soldier at Pondicherry was accustomed to give a 'certain quantity of arrack to one of these animals every 'time he got his pay; and having one day intoxicated 'himself, and being pursued by the guard, who wanted 'to put him in prison, he took refuge under the ele- 'phant, and fell fast asleep. The guard in vain at- 'tempted to drag him from this asylum; for the elephant 'defended him with its trunk. Next day the soldier 'having recovered from his intoxication was in dreadful 'apprehensions when he found himself under the belly of 'an animal so enormous. The elephant, which unques- 'tionably perceived his terror, caressed him with its 'trunk.

'The elephant is sometimes seized with a kind of 'madness, which deprives him of all tractability, and 'renders him so formidable, that it is often neces- 'sary to kill him. The people try to bind him with 'large iron chains, in the hope of reclaiming him. But 'when in his ordinary state the most acute pains will 'not provoke him to hurt those who have never injured 'him. An elephant, rendered furious by the wounds it 'had received at the battle of Hambour, ran about the 'field making the most hideous cries. A soldier, not 'withstanding the alarms of his comrades, was unable, 'perhaps on account of his wounds, to fly. The elephant 'approached, seemed afraid of trampling him under his 'feet, took him up with its trunk, placed him gently on 'his side, and continued its route.'

These notes I have transcribed verbatim. They were communicated to the Marquis de Montmirail by M. de Bussy, who resided ten years in India, and performed many important services to the state. He had several elephants under his own charge, often rode upon them, and had daily opportunities of observing many others which belonged to his neighbours. Hence these notes, as well as all the others quoted under the name of M. de Bussy, merit every degree of credit. The members of the Royal Academy of Sciences have also left us some facts which they learned from those who had the management of the elephant at Versailles, and which deserve a place in this work. 'The elephant seemed to know 'when it was mocked by any person; and remembered 'the affront till an opportunity of revenge occurred. A 'man deceived it by pretending to throw something into 'his mouth: the animal gave him such a blow with its 'trunk as knocked him down and broke two of his ribs. 'After which it trampled on him with its feet, broke 'one of his legs, and bending down on its knees endea- 'voured to push its tusks into his belly; but they 'luckily run into the ground on each side of his thigh, 'without doing him any injury. A painter wanted to 'draw the animal in an unusual attitude, with its trunk 'elevated, and its mouth open. The painter's servant, 'to make it remain in this position, threw fruits into 'its mouth, but generally made only a feint of throwing 'them. The elephant was enraged, and as if it knew 'that the painter was the cause of this teazing imper- 'tinence, instead of attacking the servant, it eyed the 'master, and squirted at him such a quantity of water 'from its trunk as spoiled the paper on which he was 'drawing.

'This elephant generally made less use of its strength 'than its address. With great ease and coolness it 'loosed the buckle of a large double leathern strap, with 'which its leg was fixed; and as the domestics had 'wrapped the buckle round with a small cord, and tied 'many knots on it, the creature deliberately loosed the 'whole, without breaking either the cord or the strap. 'One night, after disengaging itself in this manner from

'its strap, it broke up the door of its lodge with such 'dexterity as not to waken the keeper. From thence it 'went into several courts of the menagerie, forcing open 'doors, and throwing down the walls when the doors 'were too narrow to let it pass. In this manner it got 'access to the apartments of other animals, and so ter-'rified them, that they fled into the most retired corners 'of the inclosure.'

In fine, that nothing may be omitted which can contribute to throw light upon the natural and acquired faculties of an animal so superior to all others, we shall add some facts, extracted from the most respectable and unsuspicious travellers.

'Even the wild elephant,' says le P. Vincent Marie, 'has his virtues. He is generous and temperate; and 'when rendered domestic, he is esteemed for gentleness 'and fidelity to his master, friendship to his governor, '&c. If destined to the immediate service of princes, 'he recognises his good fortune, and maintains a gravity 'of demeanour, corresponding to the dignity of his 'office. If, on the contrary, less honourable labours are 'assigned to him, he turns melancholy, frets, and evi-'dently discovers that he is humbled and depressed. In 'war, during the first onset, he is fiery and impetuous. 'When surrounded with hunters he is equally brave. 'But after being vanquished he loses all courage. He 'fights with his tusks, and dreads nothing so much as 'to lose his trunk, which from its consistence is easily 'cut. I shall only add, that the elephant is mild, attacks 'no person without being injured, seems to love society, 'is particularly fond of children, whom he caresses, and 'appears to discern the innocence of their manners.'

'The elephant,' says Pyrard, 'is an animal of so 'much knowledge and judgment, that beside his infinite 'utility to man, he may be said to enjoy a certain por-'tion of reason. When about to be ridden, he is so 'obedient and well trained, that he accommodates his 'behaviour to the quality of the person he serves. He 'bends down, and assists his master to mount with his 'trunk. He is so tractable, that he will perform any 'thing that is required of him, provided he be treated 'with gentleness. He does every thing he is desired, 'caresses those who ride on him,' &c.

'By giving elephants,' say the Dutch voyagers, 'what-'ever is agreeable to them, they are soon rendered as 'tame and submissive as men. They may be said to be 'deprived of the use of language only. They are proud 'and ambitious; but they are grateful for benefits re-'ceived. They allow themselves to be led and com-'manded by a child; but they love to be praised and 'caressed. They quickly feel an injury or an affront; 'and the guilty person should be on his guard; for he 'may reckon himself happy if they content themselves 'with squirting water upon him with their trunks, or 'simply throwing him into a mire.'

'The elephant,' P. Philippe remarks, 'makes a near 'approach to the judgment and reasoning of man. 'When compared with the apes, they appear to be stupid 'and brutal animals. The elephants are so extremely 'modest, that they will not copulate in the presence of 'any person; and if by accident any man perceives 'this operation, they infallibly resent it, &c. Their 'salute is performed by bending the knees, and lowering 'the head; and when their master wants to mount 'them, they assist him with great dexterity. When a 'wild elephant is taken, the hunters tie his feet, and 'one accosts and salutes, makes apologies for binding 'him, protests that no injury is meant, tells him, that 'in his former condition he often wanted food, but that 'henceforward he shall be well treated, and that every 'promise shall be performed to him, &c. The hunter 'no sooner finishes this soothing harangue than the 'elephant follows him like a tamed lamb. We must 'not, however, conclude from hence, that the elephant 'understands language, but only that having a very 'strong discerning faculty he distinguishes esteem from 'contempt, friendship from hatred, and all the other 'emotions which men exhibit to him; and for this 'reason he is more easily tamed by arguments than by 'blows. With his trunk he throws stones very far, and 'very straight, and also uses it for pouring water on his 'body when bathing.'

'Of five elephants,' Tavernier remarks, 'which the 'hunters had taken, three escaped, though ropes and 'chains were thrown round their bodies and limbs. The 'natives told us the following most astonishing story, 'if it could be credited. When an elephant, they said, 'has once been caught in a pitfall, and escapes from 'the snare, he becomes extremely diffident, breaks off a 'large branch with his trunk, and strikes the ground 'every where before he sets down his feet, in order to 'discover by the sound whether there are any concealed 'holes by which he may be entrapped a second time. 'For this reason, the hunters who related this story 'despaired of being able, without much difficulty, to 'retake the three elephants which had made their escape. 'Each of the two elephants which had been seized were 'placed between two tame ones, and surrounded by six 'men with burning torches, who spoke to the animals, 'and presenting food to them, said in their language, '*Take this, and eat it.* The food consisted of small 'bunches of hay, pieces of black sugar, and boiled rice 'mixed with pepper. When the wild elephant refused 'to do what he was ordered, the men ordered the tame 'elephants to beat him, which they performed, the one 'striking him on the front and head, and if the captive 'animal attempted to defend himself, the other struck 'him on the side; so that the poor creature knew not 'where he was, and soon found himself obliged to 'obey.'

'I have frequently remarked,' says Edward Terry, 'that the elephant performs many actions which seem 'to proceed more from reason than from instinct. He 'does every thing that his master commands: If he 'wants to terrify any person, he runs upon him with 'every appearance of fury, and, when he comes near, 'stops short without doing him the smallest injury. 'When the master chooses to affront any man, he tells 'the elephant, who collects water and mud with his 'trunk, and squirts it upon the object pointed out to 'him. The trunk is composed of cartilage, hangs be-'tween the tusks, and is by some called his *hand*, be-'cause, on many occasions, it answers the same purposes 'as the human hand. The Mogul keeps some elephants 'who serve as executioners to criminals condemned to 'death. When the conductor orders one of these ani-'mals to dispatch the poor criminal quickly, he tears 'them to pieces in a moment with his feet. But if 'desired to torment them slowly, he breaks their bones 'one after another, and makes them suffer a punishment 'as cruel as that of the wheel.'

We might quote many other facts equally curious and interesting. But we should soon exceed the limits we have prescribed to ourselves in this work. We should not even have given so long a detail, if the elephant had not been, in many respects, the chief animal in the brute creation, and who of course merited the greatest attention.

M. Daubenton has made several useful remarks on the nature and qualities of ivory, and has restored to the elephant those prodigious tusks and bones which have been attributed to the mammouth. I acknowledge that I was long doubtful with regard to this point. I had often compared these enormous bones with the skeleton of nearly a full grown elephant preserved in the Royal Cabinet: and as before composing their history I could not persuade myself that there existed elephants six or seven times larger than the one whose skeleton I had so often examined, and as the large bones had not the same proportions with the corresponding bones of the elephant, I believed, with the generality of naturalists, that these huge bones belonged to a much larger animal, the species of which had been lost or annihilated. But it is certain, from the facts formerly mentioned, that there are elephants fourteen feet high, and, consequently, (as the masses are as the cubes of the height) six or seven times larger than that whose skeleton is in the Royal Cabinet, and which was not above seven or seven and a half feet high. It is likewise certain, that age changes the proportions of bones, and that adult animals grow considerably thicker, though their stature does not increase. In fine, it is certain, from the testimonies of travellers, that there are elephants' tusks, each of which weighs more than a hundred and twenty pounds. From all these facts it is apparent, that the prodigious bones and tusks above taken notice of are really the tusks and bones of the elephant. Sir Hans Sloane says the same thing; but brings no proof of the fact. M. Gmelin affirms it still more positively, and gives some curious facts on the subject, which deserve to be here related. But M. Daubenton appears to be the first who has put the matter beyond all doubt, by accurate mensurations, exact comparisons, and reasonings derived from the extensive knowledge he has acquired in the science of comparative anatomy.

[Mr. Eden informs us, that he measured several elephants' tusks, which he found to be nine feet long; that others were as thick as a man's thigh; and that some of them weighed ninety pounds. It is said, that in Africa some tusks have been found, each of which weighed a hundred and twenty-five pounds. The English voyagers brought from Guinea the head of an elephant which Mr. Eden saw in the possession of Mr. Judde: it was so large that the bones and cranium alone, without including the tusks, weighed about two hundred pounds; from which it was computed, that the whole parts of the head, taken in their entire state, would have weighed five hundred pounds.—*Hist. Gen. des Voyages.*

In Siberia there are prodigious quantities of bones found in different places under the ground. This part of natural history is both curious and important; I have therefore collected all the facts I could learn upon this subject. Peter the Great, who was a patron of naturalists, gave orders to his subjects, in the year 1722, that wherever any of the bones of the mammouth were discovered, the other bones belonging to the animal should be diligently sought for, and the whole sent to Petersburg. These orders were published in all the towns of Siberia, and among others, in Jakutzk, where, after this publication, a Sluschewoi, called *Wasilei Oltasow*, entered into a written obligation before Michaele Petrowitsch Ismailow, captain-lieutenant of the guard, and Woywode of the place, to travel into the interior cantons of Lena, in order to search for the bones of the mammouth; and he was dispatched thither on the 23d of April the same year. The following year another addressed the Chancery of Jakutzk, and represented, that he had travelled along with his son toward the sea, in quest of the bones of the mammouth, and that, opposite to Surjatoi Noss, about two hundred versts from that place and the sea, he found in a turfy soil, which is common in these districts, the head of a mammouth, with one of the horns adhering to it; and in the neighbourhood there was another horn of the same animal, which had probably fallen off while the creature was alive; that at a little distance they drew out of the earth another head, with the horns of an unknown animal; that this head resembled that of an ox, only it had horns above its nose; that on account of an accident which befel his eyes he was obliged to leave these heads where

they were; and that having heard of his Majesty's orders he now begged to be sent off with his son toward Vst-janskoje, Simowie, and the sea. His demand was complied with, and they were instantly dispatched. A third Sluschewoi of Jakutzk represented to the chancery, in 1724, that he made voyage on the river Jelon; that he was happy enough to discover, in a steep bank of this river, a fresh head of the mammouth, with the horn and all its parts; that he drew it out of the earth, and left it where he could find it again; and that he begged to be sent off with two men accustomed to such researches. The woywode accordingly consented. The Cossack soon after set out on his journey, and found the head and all its parts except the horns; for there remained only the half of one horn, which he brought, along with the head, to the chancery of Jakutzk. Some time after he brought two horns of the mammouth, which he also found on the river Jelon.

The Cossacks of Jakutzk were extremely happy to find, under the pretext of going in quest of the bones of the mammouth, an opportunity of making such agreeable voyages. They were furnished with five or six post horses, when one would have been sufficient, and they could employ the rest in carrying various articles of merchandise. Such an advantage was a great encouragement to adventurers. A Cossack of Jakutzk, called *Jwanselsku,* petitioned the chancery to be sent to the Simowies of Alaseisch and Kowymisch, in quest of these kind of bones, and of true crystal. He had already sojourned in these places, had collected many curious objects, and actually sent to Jakutzk some of these bones. Nothing seemed more important than this expedition; and the Cossack was dispatched on the 21st day of April, 1725.

Nasar-Koleschow, commissary of Indigirsk, in the year 1723, sent to Jakutzk, and from that to Irkutzk, the bones of a singular head, which, according to my information, was two arschines, bating three werschok, in length, one arschine high, and armed with two horns and a tusk of the mammouth. This head arrived at Irkutzk on the 14th of October, 1723; and I found the history of it in the chancery of that town. I was also assured, that the same man afterwards sent a horn of the mammouth.

These facts, collected from different sources, regard in general the same species of bones, namely, 1. All the bones in the imperial cabinet of Petersburg, under the name of *mammouth bones, will be found upon examination to have a perfect resemblance to those of the elephant.* 2. From what has been above related it appears, that there have been found in the earth heads of an animal totally different from an elephant, and which, particularly in the figure of the horns, resembled the head of an ox more than that of an elephant. Besides, this animal could not be so large as an elephant; and I have seen a head of it at Jakutzk, which had been sent from Anadirskoi-Ostrog, and was, according to my information, perfectly similar to that found by Portn-jagin. I myself had one from Ilainskoi-Ostrog, which I sent to the imperial cabinet at Petersburgh. In fine, I learned, that on the banks of Nischnaja-Tunguska similar heads are not only found every where dispersed, but likewise other bones, which unquestionably belong not to the elephant, such as shoulder bones, ossa sacra, ossa innominata, hip bones, and leg bones, which probably belonged to the same animal to which the above head ought to be attributed, and which should by no means be excluded from the ox kind. I have seen leg and hip bones of this species, concerning which I have nothing particular to remark, except that they appeared to be extremely short in proportion to their thickness. Thus in Siberia two kinds of bones are found in the earth, of which none were formerly esteemed but those which perfectly resembled the tusks of the elephant. But after the imperial order the whole began to be examined; and as the first gave rise to the fable of the mammouth the last have also been indiscriminately ranked under the same class. Neither must we believe, with Isbrand-Ides, and the followers of his reveries, that it is only in the mountains which extend from the river Ket to the north-east, and, consequently, likewise in the environs of Mangasca and Jakutzk, where the elephants' bones are to be found: for they appear not only through all Siberia, not excepting its most southern districts, as in the superior cantons of the Irtisch, Toms, and Lena, but are dispersed in different parts of Russia, and even in many places of Germany, where they are called with much propriety by the name of *fossil ivory;* for they have a perfect resemblance to elephants' teeth, except that they are in a corrupted state. In temperate climates these teeth are softened and converted into fossil ivory; but in countries frequently frozen they are generally found very fresh. From this circumstance the fable, that these and other bones are often found besmeared with blood, might easily arise. This fable has been gravely related by Isbrand-Ides, and after him by Muller; who have been copied by others with equal confidence, as if there had been no room for doubt: and as one fiction begets another, the blood pretended to be found on these bones has produced the notion, that the mammouth is an animal which lives in Siberia below the ground, where it sometimes dies, and is buried under the rubbish. All this has been invented with the view to account for the blood pretended to be found on these bones. Muller gives a description of the mammouth. This animal, says he, is four or five yards high, and about thirty feet long. His colour is greyish; his head is very long, and his front very broad. On each side, precisely under the eyes, there are two horns, which he can move and cross at pleasure. In walking he has the power of extending

and contracting his body to a great degree. His paws, in thickness, resemble those of the bear. Isbrandes-Ides is candid enough to acknowledge, that he never knew any person who had seen the mammouth alive. The heads and other bones, which correspond with those of the elephant, unquestionably once constituted real parts of that animal. To this abundance of elephants' bones we cannot refuse our assent; and I presume, that the elephants, to avoid destruction in the great revolutions which have happened in the earth, have been driven from their native country, and dispersed themselves wherever they could find safety. Their lot has been different. Some longer, and others shorter after their death, have been transported to great distances by some vast inundation. Those, on the contrary, who survived, and wandered far to the north, must necessarily have fallen victims to the rigours of the climate. Others, without reaching to so great a distance, might be drowned, or perish with fatigue. The largeness of these bones ought not to astonish us. The tusks are sometimes four arschines long, and six inches in diameter, (M. de Strahlenberg says they have been seen nine inches in diameter) and the largest weigh from six to seven puds. I mentioned, in another place, that fresh tusks have been taken from the elephant, which were ten feet long, and weighed a hundred, a hundred and forty-six, a hundred and sixty, and a hundred and sixty-eight pounds. There are pieces of fossil ivory which are yellowish, or grow yellow in the course of time; others are brown like cocoa nuts, and more lustrous; and others are of a blackish blue colour. The tusks which have not been much affected with the frost in the earth, and have remained some time exposed to the air, are subject to become more or less yellow or brown, and assume other colours, according to the species of humidity with which the air is impregnated. M. de Strahlenberg also remarks, that pieces of these corrupted teeth are sometimes of a bluish black colour. For the interest of natural history it were to be wished, that with regard to the other bones found in Siberia, we knew the animal to which they belong; but there is little hope of accomplishing this purpose.—*Relation d'un Voyage a Kamschatka*, &c.

The translation of this article was first communicated to me by M. de l'Isle, of the Academy of Sciences, and afterwards by the Marquis de Montmirail.]

SUPPLEMENT.

From comparing the male and female elephants, the former of which we saw in the year 1771, and the latter in 1773, it appears, that in general the parts of the female are grosser and more fleshy. Her ears, indeed, are proportionally smaller than those of the male: but her body is more swollen, her head larger, and her members more rounded

Like all other animals, the female elephant is more gentle than the male. Our female even caressed people with whom she was unacquainted. But the male is often formidable: the one we saw in 1771 was fiercer, less affectionate, and more ungovernable than this female. In a state of repose the genitals of the male appear not externally: his belly seems to be perfectly smooth; and it is only at the time of discharging urine that the extremity of the penis comes out of the sheath. This male elephant, though equally young with the female, was as formerly remarked, more difficult to manage. He endeavoured to lay hold of people who approached too near, and often tore their clothes. Even his governors were obliged to act with caution; but the female obeyed with complacence and alacrity. The only time she exhibited marks of displeasure was when her keepers forced her into a covered waggon, in order to be carried from one town to another. When they wanted her to enter, she refused to advance, and they could only accomplish their purpose by pricking her behind. Irritated by this ill treatment, and being unable to turn herself in her prison, she had no other method of revenge but to fill her trunk with water, and throw it in torrents upon those who had teazed her.

I remarked, in the history of the elephant, that these animals probably did not copulate in the manner of other quadrupeds; because the position of the organs in both sexes seemed to require that the female, in order to receive the male, should lie on her back. This conjecture, which appeared to be plausible, is not true; for the following testimony of M. Marcel Bles, an eye-witness, deserves full credit.

'Having perceived that the Count de Buffon, in his 'excellent work, is deceived with regard to the copula-'tion of the elephants, I know, that in several parts 'of Asia and Africa, these animals, especially during 'the season of love, remain always in the most inacces-'sible places of the forests; but in the island of Ceylon, 'where I lived twelve years, the land being every where 'inhabited, they cannot so easily conceal themselves; 'and having often examined them, I perceived that the 'female organ is situated nearly under the middle of 'the belly, which would lead us to think, with M. de 'Buffon, that the males cannot cover the females in the 'manner of other quadrupeds. However, there is only 'a slight difference of situation. When they inclined to 'copulate, I perceived that the female bowed down her 'head and neck, and leaned her two fore legs, which 'were also bended, upon the root of a tree, as if she 'meant to prostrate herself on the ground; and the 'two hind legs remained erect, which gave the male an 'opportunity of embracing her as other quadrupeds do. 'I can likewise affirm, that the females go with young 'about nine months. Moreover, the elephants never 'copulate, unless when in a state of freedom. In the

'season of love the males are strongly chained for four 'or five weeks, during which time they discharge vast 'quantities of semen, and are so furious, that their cor- 'nacks or governors cannot come near them without 'danger. The approach of the rutting season is easily 'known; for some days before it happens, an oily liquor 'flows from a small hole on each side of the head. The 'domestic female, on these occasions, sometimes makes 'her escape, and joins the wild males in the woods. 'Some days afterward her cornack goes in quest of her, 'and calls her by her name till she comes. She submits 'to him with complacence, and allows herself to be 'conducted home, and shut up in the stable. It was 'from cases of this kind that it was discovered that the 'females bring forth about the end of nine months.'

The first remark with regard to the mode of copulating seems to be unquestionable, since M. Marcel Bles assures us, that he has seen the elephants perform the operation. But as to the time of gestation, which he limits to nine months, we ought to suspend our judgment, because all travellers affirm, that the female elephant is believed to go with young no less than two years.

THE RHINOCEROS.

THE rhinoceros has one large horn, sometimes two, placed near the end of the nose; it is sometimes three feet and a half long, black, and smooth. The upper lip is long, hangs over the lower, ends in a point, is very pliable, and serves to collect its food and deliver it into the mouth. The nostrils are placed transversely. The ears are large, erect, and pointed. The eyes are small and dull. The skin is naked, rough, or tuberculated, and lies about the neck in vast folds. There is another fold from the shoulders to the fore legs, and another from the hind part of the back to the thighs. The skin is so thick, and so strong as to turn the edge of a scimitar, and resist a musket ball. The tail is slender, flatted at the end, and covered on the sides with very stiff, thick, black hairs. The belly hangs low. The legs are short, strong and thick. The hoofs are divided into three parts, each pointing forward.

Though the name of this animal be entirely Greek, it was unknown to the ancient Greeks. Aristotle takes no notice of it. Strabo is the first Greek, and Pliny the first Roman author who mentions it. The rhinoceros probably did not frequent that part of India into which Alexander had penetrated, though he met with great numbers of elephants; for it was about three hundred years after Alexander that Pompey first brought this animal to Europe.

Next to the elephant the rhinoceros is the strongest quadruped. He is at least twelve feet long from the extremity of the muzzle to the origin of the tail, and the circumference of his body is nearly equal to his length. In magnitude, therefore, he makes a near approach to the elephant; and he appears to be much less, only because his legs are proportionally shorter than those of the elephant. But he differs still more from the elephant in his natural powers and intelligence; for nature has bestowed on him nothing that elevates him above the ordinary rank of quadrupeds. He is deprived of all sensibility in his skin; neither has he hands to enable him to improve by the sense of touching; and instead of a trunk he has only a moveable lip, to which all his means of dexterity or address is limited. His chief sources of superiority over other animals consist in his strength, his magnitude, and the offensive weapon on his nose, which is entirely peculiar to him. This weapon is a very hard horn, solid throughout its whole extent, and situated more advantageously than the horns of ruminating animals, which defend only the superior parts of the head and neck. But the horn of the rhinoceros preserves from insult the muzzle, the mouth, and the face. For this reason the tiger will rather attack the elephant, whose trunk he lays hold of, than the rhinoceros, whom he dares not face without running the risk of having his bowels torn out; for the body and limbs of the rhinoceros are covered with a skin so impenetrable that he fears neither the claws of the tiger or lion, nor the sword or shot of the hunter. His skin is blackish, being of the same colour, but thicker and harder than that of the elephant, and is not sensible to the stings of flies. He can neither extend nor contract his skin, which is rolled up into large folds at the neck, the shoulders, and the crupper, in order to facilitate the motion of his head and limbs, which last are massy, and terminated by large feet, armed with three great toes. His head is proportionably longer than that of the elephant; but his eyes are still smaller, and seldom above half open. The upper, which projects over the under lip, is moveable, and can be stretched out about six or seven inches in length; and it is terminated by

a pointed appendix, which gives this animal a power of collecting herbage in handfuls, as the elephant does with its trunk. This muscular and flexible lip is a kind of hand or imperfect trunk; but it enables the creature to seize any object with force, and to feel with some dexterity. Instead of those long ivory tusks which constitute the armour of the elephant, the rhinoceros has a formidable horn, and two strong incisive teeth in each jaw. These teeth, of which the elephant is deprived, are situated at a great distance from each other, one in each angle of the jaw. The under jaw is square before; and there are no other incisive teeth in the anterior part of the mouth, which is covered by the lips. But beside the four cutting teeth, in the four corners of the mouth, there are twenty-four grinders, six on each side of the two jaws. He holds his ears always erect: in figure they resemble those of the hog; but they are proportionally smaller. The ears are the only part of the body on which there are hairs or rather bristles. The extremity of the tail, like that of the elephant, is garnished with a bush of large, solid, hard bristles.

Dr. Parsons, a celebrated physician in London, to whom the republic of letters is much indebted for many valuable discoveries in natural history, and to whom I owe the highest acknowledgments for the marks of esteem and of friendship with which he has been pleased to honour me, published, in the year 1743, a history of the rhinoceros, from which I shall the more willingly make extracts, because every composition of that gentleman merits the attention and confidence of the public.

Though the rhinoceros was frequently exhibited in the Roman spectacles, from the days of Pompey to those of Heliogabalus; though he has often been transported into Europe in more modern times; and though Bontius, Chardin, and Kolbe have drawn figures of him both in India and Africa; yet so ill was he represented and described, that he was very imperfectly known till the errors and caprices of those who had published figures of him were detected by inspection of the animals which arrived in London in the years 1739 and 1741. The figure given by Albert Durer was the first, and the least conformable to nature; yet it was copied by most naturalists, some of whom loaded it with preposterous drapery and foreign ornaments. That of Bontius is more simple and correct; but the inferior part of the legs is improperly represented. That of Chardin, on the contrary, gives a pretty good idea of the feet and the folds of the skin; but in other respects it has no resemblance to the animal. That of Camerarius is no better; neither is that drawn from the rhinoceros exhibited at London in the year 1685, and which was published by Carwitham in 1739. In fine, the figures on the ancient pavement of Præneste, and on Domitian's medals, are extremely imperfect; but they have the merit of not being deformed by the imaginary ornaments represented in the figure drawn by Albert Durer. Dr. Parsons has taken the trouble of drawing this animal himself, in three different views, before, behind, and in profile. He has likewise drawn the male organs of generation, the single and double horns, as well as the tail, from other rhinoceroses, whose parts are preserved in the cabinets of natural history.

[One of our learned philosophers, M. de Mours, has made some remarks on this subject, which must not be omitted. 'The figure,' says he, 'of the rhinoceros which 'Dr. Parsons has added to his Memoir, and which he 'drew from the life, is so different from that engraved 'at Paris in the year 1749, from a rhinoceros exhibited 'at the fair of Saint Germain, that it is difficult to 'recognise them to be the same animal. That of Dr. 'Parsons is shorter, and the folds of the skin are fewer in 'number, less marked, and some of them placed in a different position. The head, particularly, has hardly any 'resemblance to that of the Saint-Germain rhinoceros. 'We cannot however entertain a doubt with regard to the 'accuracy of Dr. Parsons. The reasons of such remarkable differences must be sought for in the age and sex of 'the two animals. That of Dr. Parsons was drawn from 'a male rhinoceros, which exceeded not the age of two 'years. That which I have here added was drawn from 'a picture of the celebrated M. Oudry, a most distinguished animal painter. He painted from the life, and 'of the natural size, the Saint-Germain rhinoceros, which 'was a female, and at least eight years old; I say, at least 'eight years; for we see by an inscription written on 'the bottom of a wooden print, entitled, *A true portrait of 'a living rhinoceros exhibited at the fair of Saint-Germain in Paris*, that this animal, when taken in 1741, 'in the province of Assem, belonging to the Mogul, 'was three years old: and eight lines lower, it is said, 'that the animal was only one month old when some 'Indians entangled it with ropes, after having slain the 'mother by their spears and darts. Hence it must have 'been at least eight years of age, and might be ten or 'twelve. This difference of age is probably the reason 'of the remarkable differences between Dr. Parsons's 'figure and that of M. Oudry, whose picture, executed 'by the order of the king, was exhibited in the painter's 'hall. I shall only remark, that M. Oudry has made 'the horn of his rhinoceros too long; for I examined 'the animal with great attention, and I find that this 'part is better represented in the wooden print. The 'horn of the present figure was drawn after this print, 'and the rest is copied from M. Oudry's picture. The 'animal which it represents was weighed, about a year 'before, at Stouquart, in the duchy of Wittemberg, and 'its weight was at that time five hundred pounds. It 'eat, according to the relation of Captain Dowemot 'Wan-dermeer, who conducted it to Europe, sixty

'pounds of hay, and twenty pounds of bread, every day. 'It was very tame, and surprisingly agile, considering 'the enormity of its mass, and its unwieldy aspect.' These remarks, like all those of M. de Mours, are judicious and sensible.

The rhinoceros which came to London in the year 1739 was sent from Bengal. Though not above two years of age, the expence of his food and journey amounted to near one thousand pounds sterling. He was fed with rice, sugar, and hay. He had daily seven pounds of rice, mixed with three pounds of sugar, and divided into three portions. He had likewise hay and green herbs, which last he preferred to hay. His drink was water, of which he took large quantities at a time. He was of a peaceable disposition, and allowed all parts of his body to be touched. When hungry or struck by any person, he became mischievous, and in both cases nothing appeased him but food. When enraged, he sprung forward, and nimbly raised himself to a great height, pushing at the same time his head furiously against the walls, which he performed with amazing quickness, notwithstanding his heavy aspect and unwieldy mass. I often observed, says Dr. Parsons, these movements produced by rage or impatience, especially in the mornings before his rice and sugar were brought to him. The vivacity and promptitude of his movements, Dr. Parsons adds, led me to think, that he is altogether unconquerable, and that he could easily overtake any man who should offend him.

This rhinoceros, at the age of two years, was not taller than a young cow that has never produced. But his body was very long and very thick. His head was disproportionally large. From the ears to the horn there is a concavity, the two extremities of which, namely, the upper end of the muzzle, and the part near the ears, are considerably raised. The horn, which was not yet above an inch high, was black, smooth at the top, but full of wrinkles directed backward at the base. The nostrils are situated very low, being not above an inch distant from the opening of the mouth. The under lip is pretty similar to that of the ox; but the upper lip has a greater resemblance to that of the horse, with this advantageous difference, that the rhinoceros can lengthen this lip, move it from side to side, roll it about a staff, and seize with it any object he wishes to carry to his mouth. The tongue of this young rhinoceros was soft, like that of a calf. [Most voyagers and all naturalists, both ancient and modern, tell us, that the tongue of the rhinoceros is very rough, and its papillæ so sharp, that with the tongue alone he tore the flesh from a man's body even to the bones. This fact, which is every where related, appears to be very suspicious and ill imagined; because the rhinoceros does not eat flesh, and animals, in general, which have rough tongues, are seldom carnivorous.] His eyes had no vivacity: in figure they resembled those of the hog, and were situated lower, or nearer the nostrils than in any other quadruped. His ears are large, thin at the extremities, and contracted at their origin by a kind of annular rugosity. The neck is very short, and surrounded with two large folds of skin. The shoulders are very thick, and at their juncture there is another fold of skin, which descends upon the fore legs. The body of this young rhinoceros was very thick, and pretty much resembled that of a cow about to bring forth. Between the body and crupper there is another fold, which descends upon the hind legs. Lastly another fold transversely surrounds the inferior part of the crupper, at some distance from the tail. The belly was large, and hung near the ground, particularly its middle part. The legs are round, thick, strong, and their joint bended backwards. This joint, which, when the animal lies, is covered with a remarkable fold of the skin, appears when he stands. The tail is thin, and proportionally short; that of the rhinoceros so often mentioned exceeded not sixteen or seventeen inches in length. It turns a little thicker at the extremity, which is garnished with some short, thick, hard hairs. The form of the penis is very extraordinary. It is contained in a prepuce or sheath, like that of the horse; and the first thing that appears in the time of erection is a second prepuce, of a flesh-colour, from which there issues a hollow tube, in the form of a funnel cut and bordered somewhat like a flower de luce, and constitutes the glans and extremity of the penis. This anomalous glans is of a paler flesh-colour than the second prepuce. In the most vigorous erection the penis extends not above eight inches out of the body; and it is easily procured by rubbing the animal with a handful of straw when he lies at his ease. The direction of this organ is not straight, but bended backward. Hence he throws out his urine behind; and from this circumstance it may be inferred, that the male covers not the female, but that they unite with their cruppers to each other. The female organs are situated like those of the cow, and she exactly resembles the male in figure and grossness of body. The skin is so thick and impenetrable, that when a man lays hold of any of the folds, he would imagine he is touching a wooden plank of half an inch thick. When tanned, Dr. Grew remarks, it is excessively hard, and thicker than the hide of any other terrestrial animal. It is every where covered more or less with incrustations in the form of galls or tuberosities, which are pretty small on the top of the neck and back, but become larger on the sides. The largest are on the shoulders and crupper, and are still pretty large on the thighs and legs, upon which they are spread all round, and even on the feet. But between the folds, the skin is penetrable, delicate, and as soft to the touch as silk, while the external part of the fold is equally hard with the rest. This tender skin between the folds is of a light flesh-

colour; and the skin of the belly is nearly of the same colour and consistence. These galls or tuberosities should not be compared, as some authors have done, to scales. They are simple indurations of the skin only, without any regularity in their figure, or symmetry in their respective positions. The flexibility of the skin in the folds enables the rhinoceros to move with facility his head, neck, and members. The whole body, except at the joints, is inflexible, and resembles a coat of mail. Dr. Parsons remarks, that this animal listened with a deep and long continued attention to any kind of noise; and that, though he was sleeping, eating, or obeying any other pressing demands of nature, he raised his head and listened till the noise ceased.

In fine, after giving this accurate description of the rhinoceros, Dr. Parsons examines whether the rhinoceros with a double horn exists; and having compared the testimonies of the ancients and moderns, and the remains of this variety in the collections of natural objects, he with much probability concludes, that the rhinoceroses of Asia have commonly but one horn, and that those of Africa have generally two.

It is unquestionably true, that some rhinoceroses have but one horn, and that others have two. But it is not equally certain that this variety is constant, and depends on the climate of Africa or India, or that this difference is alone sufficient to constitute two distinct species. It appears that the rhinoceroses with one horn have this excrescence always longer than those with two. There are single horns of three and a half, and perhaps of above four feet in length, by six or seven inches diameter at the base. Some double horns are two feet long. These horns are commonly of a brown or olive colour; though there are instances of their being gray, and even white. They have only a slight concavity, in form of a cup, under the base, by which they are fixed to the skin of the nose. The rest of the horn is solid and harder than common horn. It is with this weapon that the rhinoceros is said to attack and sometimes mortally wound the largest elephants, whose tall legs give the rhinoceros an opportunity of striking, with his snout and horn, their bellies, where the skin is most tender and penetrable. But if he misses his first blow, the elephant throws him on the ground and kills him.

The horn of the rhinoceros is more esteemed by the Indians than the ivory of the elephant, not on account of its real utility, though they make several toys of it with the chisel and turner's lathe, but on account of certain medicinal qualities they ascribe to it.

[In those parts of Bengal which border on the Ganges, the rhinoceroses or unicorns, there called *abades*, are very common, and numbers of their horns are brought to Goa. They are about two palms in circumference at the base, gradually taper to a point, and serve the animal as a defensive weapon. They are of an obscure colour, and the cups made of them are highly esteemed, especially if they have the power of counteracting poisonous liquors.—*Voyage du P. Philippe.*

Every part of the rhinoceros's body is medicinal. His horn is a powerful antidote against all kinds of poison; and the Siamese make a great article of traffic with it among the neighbouring nations. Some of them are sold for more than a hundred crowns. Those which are of a bright gray colour, and spotted with white, are most valued by the Chinese.—*Hist. Nat. de Siam.*

The horns, teeth, toes, flesh, skin, blood, and even their urine and excrements, are in great request among the Indians, as powerful remedies for different diseases.—*Voyage de la Comp. des Indes d'Hollande.*

His horn is placed between the two nostrils; it is very thick at the base, and terminates in a sharp point: it is of a greenish brown colour, and not black, as some authors maintain. When very gray, or approaching to white, it brings a high price. But it is always dear, on account of the value put on it by the Indians.—*Idem.*

The white horns, being rarest, are in great request. Among the presents sent by the king of Siam to Lewis XIV. in the year 1686, were six horns of the rhinoceros. In the royal cabinet we have twelve, of different sizes; and one of them, though cut, is three feet eight inches and a half long.

The rhinoceros, without being ferocious, carnivorous, or even extremely wild, is, however, perfectly untractable. He is nearly among large what the hog is among small animals, rash and brutal, without intelligence, sentiment, or docility. He seems even to be subject to paroxysms of fury, which nothing can appease; for the one which Emanuel King of Portugal sent to the Pope in the year 1513 destroyed the vessel in which they were transporting him; and the rhinoceros which we lately saw in Paris was drowned in the same manner in its voyage to Italy. Like the hog, these animals are fond of wallowing in the mire. They love moist and marshy grounds, and never quit the banks of rivers. They are found in Asia and Africa, in Bengal, Siam, Laos, Mogul, Sumatra, at Java in Abyssinia, in Æthiopia, in the country of the Anzicos, and as far as the Cape of Good Hope. But in general the species is not numerous, and much less diffused than that of the elephant. The female produces but one at a time, and at considerable intervals. During the first month the young rhinoceros exceeds not the size of a large dog. When recently brought forth, it has no horn, though the rudiments of it appear in the fœtus. At the age of two years the horn exceeds not an inch in length, and at the age of six it is from nine to ten inches long. Now as some of these horns are known to be near four feet in length, it appears, that they continue to grow during the half, or perhaps during the whole of the animal's life, which must be consider-

ably long, since the rhinoceros described by Dr. Parsons had only acquired about one half of its height at the age of two years; from which we may conclude, that this animal, like man, should live seventy or eighty years.

Without the capacity of becoming useful, like the elephant, the rhinoceros is equally hurtful by his voracity, and particularly by the great waste he makes in the cultivated fields. He is of no use till he is slain. His flesh is reckoned excellent by the Indians and Negroes; and Kolbe says he often eat it with pleasure. His skin makes the hardest and best leather in the world; and not only his horn, but all the other parts of his body, and even his blood, urine, and excrements, are esteemed to be antidotes against poison, or remedies for particular diseases. These antidotes or remedies, extracted from different parts of the rhinoceros, are of equal use in the Indian pharmacopeia as the theriaca in that of Europe. Most of the virtues ascribed to both are probably imaginary: but how many objects are in the highest repute which have no value but in the opinions of men?

The rhinoceros feeds on the grossest herbs, as thistles and thorny shrubs, which he prefers to the soft pasture of the best meadows. He is fond of the sugar cane, and likewise eats all kinds of grain. Having no appetite for flesh, he neither disturbs the small, nor fears the large animals, but lives in peace with all, not excepting the tiger, who often accompanies the rhinoceros without daring to attack him. This peaceful disposition renders the combats between the elephant and rhinoceros very suspicious: such combats must at least be rare, since there is no motive to war on either side. Besides, no antipathy has ever been remarked between these animals. They have been known, even in a state of captivity, to live peaceably together, without discovering any marks of resentment or antipathy.

[The Dutch history, entitled *l'Ambassade de la Chine*, gives a false description of this animal, especially when it exhibits the rhinoceros as the chief enemy of the elephant; for the rhinoceros I am mentioning was kept in the same stable with two elephants, and I have several times seen them near each other without discovering the smallest antipathy. An Æthiopian ambassador had brought this animal as a present.—*Voyage de Chardin.*]

Pliny, I believe, is the first author who mentions these combats between the elephant and rhinoceros. It appears that these animals were compelled to fight at the Roman spectacles; and from hence probably the idea was formed, that when in their natural state of liberty they fight in the same manner. But every action without a motive is unnatural; it is an effect without a cause, which cannot happen but by accident.

The rhinoceroses assemble not, nor march in troops, like the elephants. They are more solitary and savage; and it is perhaps more difficult to hunt and to overcome them. They never attack men unless they are provoked, when they become furious and formidable. Their skin is so hard as to resist sabres, lances, javelins, and even musket balls.

[His skin is thick, hard, and rough. It is even impenetrable by the sabres of the Japanese, and coats of arms, bucklers, &c. are made of it.—*Voyage de la Comp. des Indes d'Hollande.*

The rhinoceros seldom attacks men, unless when provoked, or the person wears a red habit. In both these cases he becomes furious, and overturns every thing that opposes him. When these animals attack a man, they seize him by the middle of the body, and toss him up with such force that he is killed by the fall. However enraged he may be it is easy to avoid his approach: he is indeed very swift; but he turns with great difficulty. Besides, according to my information, he sees only what is before him. Hence, when he comes within a few paces we have only to step to a side; for he then loses sight of us, and it is very difficult for him to turn in quest of us. I have experienced this fact, having more than once seen him advance toward me with all his fury.—*Kolbe's Descript.*]

The only penetrable parts of the body are the belly, the eyes, and about the ears. Hence the hunters, instead of attacking him face to face, follow him at a distance by the tracks of his feet, and watch till he lies down to sleep. We have in the royal cabinet a fœtus of a rhinoceros, which was extracted from the body of the mother, and sent to us from the island of Java. By the memoir which accompanied this fœtus, we are informed, that twenty-eight hunters having assembled to attack the mother, they followed her at a distance for some days, detaching one or two of their number from time to time in order to reconnoitre her situation; that by this means they surprised her when asleep, and silently approached so near, that the whole twenty-eight muskets were discharged at once into the lower part of her belly.

[It is difficult to kill the rhinoceros; and men never attack him without danger of being torn to pieces. Those who are accustomed to hunt the rhinoceros find means, however, to defend themselves from his fury; for he is fond of marshy grounds; they observe when he repairs thither, and concealing themselves among the bushes opposite to the direction of the wind, they watch till he lies down either to sleep or to wallow, that they may have an opportunity of shooting him near the ears, where alone he can receive a mortal wound. They place themselves against the wind; because the scent of the rhinoceros is so acute, that he never approaches any object he perceives till the smell of it reaches his nostrils.—*Hist. Nat. de Siam.*]

From the description given by Dr. Parsons, it appears that this animal has an acute and very attentive ear.

We are likewise assured that his sense of smelling is excellent. But it is said, that his eyes are not good, and that he sees such objects only as are before him. The extreme minuteness of his eyes, their low, oblique, and deep situation, the dullness, and the small degree of motion they seem to possess, tend to confirm this fact. His voice, when he is in a state of tranquillity, is blunt, and resembles the grunting of a hog; but when enraged it becomes sharp, and is heard at a great distance. Though he lives on vegetables only, he does not ruminate. Hence it is probable that, like the elephant, he has but one stomach, and capacious bowels, which supply the place of many stomachs. His consumption of food, though considerable, is not near so great as that of the elephant; and it appears, from the density and uninterrupted thickness of his skin, that he also loses much less by perspiration.

[The eyes of the rhinoceros are very small, and he sees only forward. When he walks, or pursues his prey, he proceeds always in a direct line, forcing, overturning, and piercing through every obstruction that falls in his way. Neither bushes, nor trees, nor thickets of brambles, nor large stones, can turn him from his course. With the horn on his nose he tears up trees, raises stones high in the air, and throws them behind him to a considerable distance, and with a great noise: in a word, he overthrows every object which he can lay hold of. When he is enraged, and meets with no obstruction, lowering his head, he plows the ground, and throws large quantities of earth over his head. He grunts like a hog: his cry, when in a state of tranquillity, does not reach far; but when in pursuit of his prey it may be heard at a great distance.—*Kolbe's Descript.*]

SUPPLEMENT.

I have seen a second rhinoceros, which was lately brought to the royal menagerie. In the month of September, 1770, if the people who conducted it can be credited, the animal was only three months old. But I am persuaded, that it was at least two or three years of age; for its body, including the head, was already eight feet two inches long, five feet six inches high, and eight feet two inches in circumference. A year afterward its body was lengthened seven inches; so that, on the 28th day of August, 1771, it was eight feet nine inches, including the length of the head, five feet nine inches high, and eight feet nine inches in circumference. On the 12th day of August, 1772, the length of the body, comprehending the head, was nine feet four inches, the height of the crupper six feet four inches, and that of the withers only five feet eleven inches. Its skin had the colour and appearance of an old elm tree, spotted in some places with black and gray, and in others doubled into deep furrows, which formed a kind of scales. It had only one horn, the colour of which was brown, and its substance solid and hard. The eyes were small and prominent, the ears large, and pretty similar to those of an ass. The back, which was hollow, or depressed, seemed to be covered with a natural saddle. The legs were short and very thick. The feet were rounded behind, and divided before into three hoofs. The tail resembled that of an ox, and was garnished with black hairs at the extremity. The penis lay along the testicles, and erected itself for the discharge of urine, which the animal threw out to a great distance. The point of it was also very remarkable, forming a cavity like the mouth of a trumpet. The sheath from which it issues is fleshy, and of a vermillion colour, like the penis itself. This fleshy substance, which formed the first tube, came out of a second sheath composed of skin, as in other quadrupeds. The tongue is so hard and rough, that it tears off the skin of any person whom it licks; hence this animal eats large thorns without feeling any pain. The rhinoceros requires one hundred and sixty pounds of food every day. His flesh is much relished by the Indians and Africans, and especially by the Hottentots. If trained when young he might be rendered domestic, and in this state he would multiply more easily than the elephant.

'I could never discover the reason, (M. P. remarks,) 'why in Asia the rhinoceros is allowed to remain in a 'wild state, while in Abyssinia he is rendered domestic, 'and is employed in carrying burdens.'

'M. de Buffon,' says Mr. Bruce, 'conjectured that 'there were in the interior parts of Africa rhinoceroses 'with two horns. This conjecture is fully verified; for 'all the rhinoceroses I saw in Abyssinia had two horns. 'The first, that is, the one nearest the nose, is of the 'common form; the second is sharp at the point, and 'always shorter than the first. Both spring at the 'same time; but the first grows more quickly, and ex-'ceeds the other in size, not only during the time of 'growth, but during the whole life of the animal.'

On the other hand M. Allamand, a very able naturalist, wrote to M. Daubenton a letter, dated at Leyden, October 31, 1766, in the following terms:

'I recollect a remark of Mr. Parsons, in a passage 'quoted by M. de Buffon; he suspected that the rhino-'ceroses of Asia have but one horn, and those of the 'Cape of Good Hope have two. I suspect the very 'opposite: the heads of the rhinoceroses which I re-'ceived from Bengal and other parts of India, had always 'double horns, and all those which came from the Cape 'of Good Hope had but one horn.'

This last passage proves what we have formerly remarked, that the rhinoceroses with double horns form a variety in the species, a particular race, which is found equally in Asia and Africa.

THE CAMEL AND DROMEDARY.

THERE are two species of the camel, the Bactrian camel, and the Arabian camel or dromedary. They have no cutting teeth in the upper jaw. The upper lip is divided, like that of the hare; and they have six cutting teeth in the lower jaw. The Bactrian camel has two bunches on the back, a small head, short ears, and a long slender bending neck. The height, to the top of the bunches, is six feet six inches. The hair is soft, longest about the neck, under the throat, and about the bunches. The colour of the hair on the protuberances is dusky, on the other parts it is a reddish ash-colour. The tail is long, the hairs on the middle are soft, and coarse, black, and long on the sides. The hoofs are small; the feet flat, divided above, but not through. The bottom of the feet is excessively tough, yet pliant. There are six callosities on the legs, one on each knee; one on the inside of each fore leg, on the upper joint; one on the inside of the hind leg, at the bottom of the thigh; another on the lower part of the breast, the places that the animal rests on when it lies down.

The names *camel* and *dromedary* signify not two different species, but only two distinct races of the camel, which have subsisted long previous to the records of history. The chief and perhaps the only sensible character by which these two races are distinguished is, that the camel has two bunches on the back, and the dromedary but one. The latter is also somewhat smaller and weaker than the camel. But both of them intermix and produce; and the individuals which proceed from this crossing of the races are the most vigorous, and preferred to all others. These mongrels form a secondary race, which multiply among themselves, and likewise mix with the primary races. Hence, in this species, as well as in those of other domestic animals, there are many varieties, the most general of which proceed from the influence of different climates.

[The Persians have several kinds of camels. Those with two bunches they call *bughur*, and those with one *schuttur*. Of these last there are four kinds. Those called from their excellence *ner*, that is *male*, which proceed from a mixture of a dromedary, or a camel with two bunches, and a female with one bunch, which is called *maje*, are never allowed to be covered by others, and are so highly esteemed, that some of them sell for a hundred crowns. They carry loads of nine or ten hundred pounds, and are most indefatigable. When in season they eat little, foam at the mouth, grow enraged, and bite. To prevent them from hurting their keepers the Persians put muzzles on their mouths, which are called *agrah*. The camels which proceed from this kind degenerate much, and become weak and indolent. It is for this reason that they are called *jurda kaidem* by the Turks, and sell at thirty or forty crowns only.

The third kind, called *lohk*, are not so good as the *bughur*. When in season they foam not, but push out from under their throat a red bladder, which they again retract with their breath, raise their heads, and often swell. They sell at sixty crowns, and are by no means so strong as the other kinds. Hence the Persians, when they speak of a valiant man, say that he is a *ner*, and a poltroon is called *lohk*. A fourth kind are called by the Persians *schuturi baad*, and by the Turks, *jeldovesi*, that is, *wind camels*. They are smaller, but more sprightly than the other kinds; for instead of walking, like ordinary camels, they trot and gallop as well as horses.—*Voyage d'Olearius.*]

Aristotle has marked the two principal races with much propriety; the first, or the one with two bunches, under the name of the *Bactrian camel*, and the second under that of the *Arabian camel*. The first are called *Turkish camels*, and the other *Arabian camels*.

[We went to Mount Sinai upon camels, because there is no water on this road, and other animals cannot travel without drinking. But the Arabian camels, which are small, and different from those of Cairo, who come from Sour and other places, can travel three or four days without drink. They travel from Cairo to Jerusalem, not only upon these small Arabian camels, but upon a larger kind, which are called Turkish camels.—*Voyage de Pietro della Valle.*

In Barbary the dromedary is called *maihari;* and is not so common in Barbary as in the Levant. This species differs from the ordinary camel by having a rounder and handsomer body, and only one small bunch on the back.—*Shaw's Travels.*]

This distinction still subsists; but as many parts of Asia and Africa are now discovered, which were unknown to the ancients, it appears, that the dromedary is incomparably more numerous, and more generally diffused than the camel. The latter is found only in Turkestan, and some other places of the Levant.

[The Academy having ordered the missioners sent to China, in quality of king's mathematicians, to obtain information concerning some particulars in the history of the camel, the Persian ambassador gave the following answers to the queries put to him by M. Constance: 1. That in Persia there were camels with two bunches on the back; but that they came originally from Turkestan, and belong to the race of those which the King of the Moors had brought from that country, the only known part of Asia where this kind exists; and that those camels were highly esteemed in Persia, because

their two bunches render them more proper for carriages. 2. That these bunches are not formed by a curvature of the back bone, which is here as low as in any other part, but are only excrescences of a glandulous substance, similar to that which composes the udders of other animals; and that the interior bunch is about six inches high, and the posterior an inch lower.—*Mem. pour servir a l'Hist. des Animaux.*

The camels of the Calmuck Tartars are pretty large and strong; but they have all two bunches.—*Relation de la Grande Tartarie.*]

But in Arabia the dromedary is more common than any other beast of burden. It is likewise very numerous in all the northern parts of Africa, from the Mediterranean sea to the river Niger. It is also found in Egypt, in Persia, in South Tartary, and in the northern parts of India. Thus the dromedary occupies immense territories, and the camel is confined within narrow limits. The first inhabits dry and hot regions, the second, countries which are less dry and more temperate; and the whole species, including both varieties, seems to be limited to a zone of three or four hundred leagues in breadth, extending from Mauritania to China; for on either side of this zone it has no existence. This animal, though a native of warm climates, dreads those which are excessively hot. The species terminates where that of the elephant commences; and it can neither subsist under the burning heat of the Torrid Zone, nor under the mild air of the Temperate. It seems to be an original native of Arabia; for this is not only the country where they are most numerous, but where they thrive best. Arabia is the driest country in the world, and where water is most rare. The camel is the most sober of all animals, and can pass several days without drink. The soil is almost every where dry and sandy. The feet of the camel are adapted for walking on sands, and the animal cannot support itself on moist and slippery ground. This soil produces no pasture; the ox is also wanting; and the camel supplies his place.

[Arabia is the native country of camels; for though they are found in all places into which they have been carried, and even multiply in these places; yet there is no part of the earth where they are equally numerous.—*Voyage du P. Philippe.*

Without the assistance of camels it would be extremely difficult to traverse the vast deserts of Solyma, where neither bird, wild beast, herbage, nor even a mushroom can be found, and where nothing is to be seen but mountains of sand, rocks, and camels' bones. These animals sometimes pass six or seven days without drinking, which I should never have believed if I had not seen the fact verified.—*Relation du Voyage de Poncet et Ethiopie*, &c.

In going from Aleppo to Ispahan, by the great desert, we travelled near six days without finding water, which, added to the three preceding, make the nine days I formerly mentioned, during which our camels had no drink.—*Voyage de Tavernier.*

Camels cannot walk upon fat or slippery ground. They are only fit for sandy places.—*Voyage de Jean Ovington.*

There are chiefly two kinds of camels, the one proper for warm countries, the other for cold. The camels of very warm countries, as those which come from Ormus, and as far as Ispahan, cannot walk when the ground is moist and slippery; for by the spreading of their hind legs they are in danger of tearing open their bellies: they are small, and carry loads of only six or seven hundred pounds. The camels of colder countries, as those from Tauris to Constantinople, are large, and commonly carry burdens of one thousand pounds. They draw themselves out of miry ground; but when the earth is fat and slippery, they are obliged to go, sometimes to the number of a hundred, at each others sides, in order to pass over it.—*Voyage de Tavernier.*]

When we consider the nature and structure of these animals, we cannot be deceived with regard to their native country, which must be suited to their frame and temperament, especially when these are not modified by the influence of other climates. In vain have attempts been made to multiply them in Spain; in vain have they been transported to America. They have neither succeeded in the one country nor in the other; and in the East Indies they are not found beyond Surat and Ormus. [Camels are frequently seen in Spain. They are sent, by the governors of places, from the frontiers of Africa. But they never live long there, because the country is too cold for them.—*L'Afrique de Marmol.*] We mean not to say absolutely, that they cannot subsist and produce in India, Spain, and America, and even in colder countries, as those of France, Germany, &c. [M. le Marquis de Montmirail informs me, that he was assured that the King of Poland had in the neighbourhood of Dresden camels and dromedaries which multiplied.] By keeping them, during the winter, in warm stables; by feeding them well, and treating them with care; by not employing them in labour, and not allowing them to go out for exercise, but in fine weather, their lives might be preserved, and we might even hope to see them produce. But such productions are rare and feeble; and the parents themselves are weak and languid. In these climates, therefore, they lose all their value, and instead of being useful, they cost their owners much expence in the rearing. But in their native country they constitute the sole riches of their masters. The Arabians regard the camel as a present from heaven, a sacred animal, without whose assistance they could neither subsist, carry on trade, nor travel. Camel's milk is the common food of the Arabians. They also eat its flesh, that of the young camel being reckoned highly savoury. Of the

hair of those animals, which is fine and soft, and which is completely renewed every year, the Arabians make stuffs for clothes, and other furniture.

[In spring the hair of the camel falls off so entirely that he resembles a scalded hog. He is then smeared all over with pitch, to defend him from the flies. The hair of the camel is a fleece superior to that of any other domestic animal. In these countries it is made into very fine stuffs, and in Europe hats are made of it, by mixing it with beaver's hair.—*Voyage de Chardin.*

In the spring the whole hair falls from the camel in less than three days. The skin is completely naked, and then the flies become exceedingly troublesome, against which there is no other remedy but besmearing the whole body with pitch.—*Voyage de Tavernier.*]

With their camels the Arabs not only want nothing, but have nothing to fear. In one day they can perform a journey of fifty leagues into the desert, which cuts off every approach from their enemies. All the armies of the world would perish in pursuit of a troop of Arabs. Hence they never submit, unless from choice, to any power. Figure to yourselves a country without verdure, and without water, a burning sun, an air always parched, sandy plains, mountains still more adust, which the eye runs over without perceiving a single animated being; a dead earth, perpetually tossed with the winds, and presenting nothing but bones, scattered flints, rocks perpendicular or overturned; a desert totally void, where the traveller never breathes under a shade, where nothing accompanies him, nothing recalls the idea of animated nature: absolute solitude, more dreadful than that of the deepest forests; for to man trees are at least visible objects: more solitary and naked, more lost in an unlimited void, he every where beholds space surrounding him as a tomb: the light of the day, more dismal than the darkness of night, serves only to give him a clearer view of his own wretchedness and impotence, and to conceal from his view the barriers of the void, by extending around him that immense abyss which separates him from the habitable parts of the earth; an abyss, which in vain he should attempt to traverse; for hunger, thirst, and scorching heat, haunt every moment that remains to him between despair and death.

The Arab, however, by the assistance of his camel, has learned to surmount, and even to appropriate, these frightful intervals of Nature. They serve him for an asylum, they secure his repose, and maintain his independence. But man never uses any thing without abuse! This same free, independent, tranquil, and even rich Arab, instead of regarding his deserts as the ramparts of his liberty, pollutes them with his crimes. He traverses them to carry off slaves and gold from the adjacent nations. He employs them for perpetrating his robberies, which unluckily he enjoys more than his liberty; for his enterprises are almost always successful. Notwithstanding the vigilance of his neighbours, and the superiority of their strength, he escapes their pursuit, and carries off with impunity all that he ravages from them. An Arab who gives himself up to this kind of terrestrial piracy is early accustomed to the fatigues of travelling, to want of sleep, and to endure hunger, thirst, and heat. With the same view he instructs, rears, and exercises his camels. A few days after their birth he folds their limbs under their belly, forces them to remain on the ground, and in this situation loads them with a pretty heavy weight, which is never removed but for the purpose of replacing a greater. Instead of allowing them to feed at pleasure, and to drink when they are dry, he begins with regulating their meals, and makes them gradually travel long journeys, diminishing at the same time the quantity of their aliment. When they acquire some strength, they are trained to the course. He excites their emulation by the example of horses, and in time renders them equally swift, and more robust. In fine, after he is certain of the strength, fleetness, and sobriety of his camels, he loads them both with his own and their food, sets off with them, arrives unperceived at the confines of the desert, robs the first passengers he meets, pillages the solitary houses, loads his camels with the booty, and, if pursued, he is obliged to accelerate his retreat. It is on these occasions that he unfolds his own talents and those of the camels. He mounts one of the fleetest, conducts the troop, and makes them travel night and day, without almost either stopping, eating, or drinking; and in this manner he easily performs a journey of three hundred leagues in eight days. During this period of motion and fatigue, his camels are perpetually loaded, and he allows them each day one hour only for repose, and a ball of paste. They often run in this manner nine or ten days without finding water; and when by chance there is a pool at some distance, they scent the water half a league off. Thirst makes them double their pace, and they drink as much at once as serves them for the time that is past, and as much to come; for their journeys often last several weeks, and their abstinence continues an equal time.

[The dromedary is particularly remarkable for swiftness. The Arabs say that he can travel as far in one day as one of their best horses can do in eight or ten. The *behk*, who conducted us to Mount Sinai, was mounted on one of these camels, and often amused us with the great fleetness of the animal on which he rode. He quitted our caravan to reconnoitre another, which was so distant that we could hardly perceive it, and returned to us in less than a quarter of an hour.—*Shaw's Travels.*

A kind of camels are reared in Arabia for the purposes

of the course. They trot so fleetly that a horse cannot keep up with them unless at a gallop.—*Voyage de Chardin.*

The dromedaries are so fleet that they march thirty-five or forty leagues a day, and continue at this rate for eight or ten days through the desert, and eat extremely little. They are used by the Arabs of Numidia and the Lybian Africans as post horses, when a long journey is necessary; they likewise mount these animals in the time of combat.—*L'Afrique de Marmol.*

The true dromedary is much lighter and swifter than the other camels; he can travel a hundred miles in a day, and continue at the same rate across the deserts, with very little food, for seven or eight days.—*L'Afrique d'Ogilby.*

The dromedaries are smaller, more slender, and fleeter than the other camels, and are used only for carrying men. They have a fine soft trot, and easily accomplish forty leagues a-day. The rider has only to keep a firm seat; and some people, for fear of falling, are tied on.—*Relation de Thevenot.*

The camel can dispense with drinking during four or five days. A small quantity of beans and barley, or rather some morsels of paste made of flour, are sufficient for his daily nourishment. This fact I often experienced in my journey to Mount Sinai. Though each of our camels carried seven quintals, we travelled ten, and sometimes fifteen hours a-day, at the rate of two and a half miles every hour.—*Shaw's Travels.*

The patience with which the camels suffer thirst is truly admirable. The last time I travelled the deserts, which the caravan did not clear in less than sixty-five days, our camels were once nine days without drink; because during all this time we found no water.—*Voyage de Tavernier.*

We arrived at a hilly country: at the foot of the hills were large pools. Our camels, which had passed nine days without drink, smelled the water at the distance of half a league, they instantly began their hard trot, which is their mode of running, and entering the pools in troops, they first troubled the water, &c.—*Idem.*]

In Turkey, Persia, Arabia, Egypt, Barbary, &c. all the articles of merchandise are carried by camels. Of all carriages it is the cheapest and most expeditious. The merchants and other passengers unite in a caravan, to prevent the insults and robberies of the Arabs. These caravans are often very numerous, and are always composed of more camels than men. Each camel is loaded in proportion to his strength; and when overloaded, he refuses to march, and continues lying till his burden is lightened. The large camels generally carry a thousand, or even twelve hundred pounds weight, and the smallest from six to seven hundred. In these commercial travels their march is not hastened: as the route is often seven or eight hundred leagues, their motions and journeys are regulated. They walk only, and perform about from ten to twelve leagues each day. Every night they are unloaded, and allowed to pasture at freedom. When in a rich country or fertile meadow, they eat in less than an hour as much as serves them to ruminate the whole night, and to nourish them during twenty-four hours. But they seldom meet with such pastures; neither is this delicate food necessary for them. They even seem to prefer wormwood, thistles, nettles, broom, cassia, and other prickly vegetables, to the softest herbage. As long as they find plants to browse they easily dispense with drink.

[The camels are very commodious for carrying baggage and merchandise at a small expence. Their steps, as well as their journeys, are regulated. Their food is cheap; for they live on thistles, nettles, &c. They suffer drought two or three days.—*Voyage d'Olearius.*

When about to be loaded, at the command of their conductor they instantly bend their knees. If any of them disobey, they are immediately struck with a stick, or their necks are pulled down; and then, as if constrained, and complaining in their own manner, they bend their knees, put their bellies on the earth, and remain in this posture till they are loaded and desired to rise. This is the origin of those large callosities on the parts of their bellies, limbs, and knees, which rest on the ground. If overburdened, they give repeated blows with their heads to the person who oppresses them, and set up lamentable cries. Their ordinary load is double that which the strongest mule can carry.—*Voyage du P. Philippe.*

Some camels can carry loads of fifteen hundred pounds. But they are never burdened in this manner, unless when the merchants approach the places where the imposts on goods are levied, which they mean partly to evade, by laying as much on one camel as was carried before by two. But with this great load they travel not above two or three leagues a-day.—*Voyage de Tavernier.*

In the east the camel is called *a land ship*, on account of the great load he carries, which for large camels is generally twelve or thirteen hundred pounds; for there are two kinds, the *northern* and the *southern*, as they are denominated by the Persians. The latter, who travel only from the Persic Gulf to Ispahan, are much smaller than the others, and carry only about seven hundred pounds; but they bring as much if not more profit to their masters, because their food hardly costs any thing. They march loaded in this manner, pasturing along the road, without bridle or halter.—*Voyage de Chardin.*

When the camels are unloaded, they are allowed to go in quest of briars or brambles. Though the camel is a large animal he eats little, and is content with what he finds. He searches particularly for thistles, of which he is very fond.—*Voyage de Tavernier.*]

Their facility of abstaining long from drink proceeds

not from habit alone, but is rather an effect of their structure. Independent of the four stomachs, which are common to ruminating animals, the camels have a fifth bag, which serves them as a reservoir for water. This fifth stomach is peculiar to the camel. It is so large as to contain a vast quantity of water, where it remains without corrupting, or mixing with the other aliments. When the animal is pressed with thirst, and has occasion for water to macerate his dry food in ruminating, he makes part of this water mount into his paunch, or even as high as the œsophagus, by a simple contraction of certain muscles. It is by this singular structure that the camel is enabled to pass several days without drinking, and to take at a time a prodigious quantity of water, which remains in the reservoir pure and limpid, because neither the liquors of the body, nor the juices of digestion, can mix with it.

If we reflect on the dissimilarities in this animal from other quadrupeds, we cannot doubt that his nature has been considerably changed by constraint, slavery, and perpetual labour. Of all animals the camel is the most ancient, the completest, and the most laborious slave. He is the most ancient slave, because he inhabits those climates where men were first polished. He is the most complete slave, because in the other species of domestic animals, as the horse, the dog, the ox, the sheep, the hog, &c. we still find individuals in a state of nature, and which have never submitted to men. But the whole species of the camel is enslaved; for none of them exist in their primitive state of liberty and independence. Lastly, he is the most laborious slave; because he has never been nourished for pomp, like most horses, nor for amusement, like most dogs, nor for the use of the table, like the ox, the hog, and the sheep; because he has always been made a beast of burden, whom men have never taken the trouble of yoking in machines, but have regarded the body of the animal as a living carriage, which they may load, or overload, even during sleep; for when hurried the load is sometimes not taken off, but he lies down to sleep under it, with his legs folded, and his body resting on his stomach. Hence these animals perpetually bear the marks of servitude and pain. Upon the under part of the breast there is a large callosity as hard as horn, and similar ones on the joints of the limbs. Though these callosities are found on all camels, they exhibit a proof that they are not natural, but produced by excessive constraint and painful labour, for they are often filled with pus. The breast and legs, therefore, are deformed by callosities; the back is still more disfigured by one or two bunches. The callosities as well as the bunches are perpetuated by generation. [Having opened the callosities on the legs to examine their structure, which is a medium between fat and ligament, we found, in a small camel, that some of them contained a collection of thick pus. The callosity on the sternum was eight inches long, six broad, and two thick. In it likewise we found a great deal of pus.—*Mem. pour servir a l'Hist. des Animaux.*]

As it is obvious that the first deformity proceeds from the constant practice of forcing these animals, from their earliest age, to lie on their stomach with their limbs folded under the body, and in this situation to bear both the weight of their own bodies, and that of the loads laid on their backs, we ought to presume that the bunch or bunches have also originated from the unequal pressure of heavy burdens, which would naturally make the flesh, the fat, and the skin, swell; for these bunches are not osseous, but composed of a fleshy substance similar to that of a cow's udder. [As soon as a camel is brought forth, his fore legs are folded under his body. After which he is covered with a cloth, which hangs down to the ground, and on the borders of which a quantity of stones are laid, to prevent him from rising, and in this position he remains fifteen or twenty days. He is served with milk but very sparingly, in order to accustom him to drink little.—*Voyage de Tavernier.*]

Hence the callosities and bunches should be equally regarded as deformities produced by continual labour and bodily constraint; and though at first accidental and individual, they are now become permanent and common to the whole species. We may likewise presume, that the bag which contains the water, and is only an appendix to the paunch, has been produced by an unnatural extension of this viscus. The animal, after suffering thirst for a long time, by taking at once as much, and perhaps more water than the stomach could easily contain, this membrane would be gradually extended and dilated; in the same manner as we have seen the stomach of a sheep extend in proportion to the quantity of its aliment. In sheep fed with grain the stomach is very small; but becomes very large in those fed with herbage alone.

These conjectures would be either fully confirmed or destroyed if we had wild camels to compare with the domestic. But these animals no where exist in a natural state, or if they do, no man has observed or described them. We ought to suppose, therefore, that every thing good and beautiful belongs to nature, and that whatever is defective and deformed in these animals proceeds from the labour and slavery imposed on them by the empire of man. These inoffensive creatures must suffer much; for they utter the most lamentable cries, especially when overloaded. But though perpetually oppressed, their fortitude is equal to their docility. At the first signal they bend their knees, and lie down to be loaded, which saves their conductor the trouble of raising the goods to a great height. As soon as they are loaded, they rise spontaneously, and without any assistance. One of them is mounted by their conductor, who goes before, and regulates the march of all the fol-

lowers. They require neither whip nor spur. But when they begin to be tired, their courage is supported, or rather their fatigue is charmed, by singing, or by the the sound of some instrument. Their conductors relieve each other in singing; and when they want to prolong the journey, they give the animals but one hour's rest; after which, resuming their song, they proceed on their march for several hours more, and the singing is continued till they arrive at another resting-place, when the camels again lie down; and their loads, by unloosing the ropes, are allowed to glide off on each side of the animals. Thus they sleep on their bellies in the middle of their baggage, which next morning is fixed on their backs with equal quickness and facility as it had been detached the evening before.

[The camels are so obedient to their masters, that when he wants to load or unload them, by a single word or signal they instantly lie down on their bellies. Their food is scanty, and their labour great.—*Cosmog. du Levant.*

They are accustomed to lie down to be loaded, by having their legs folded under them when very young; and their obedience is so prompt as to excite admiration. Whenever the caravan arrives at the place of encampment, all the camels which belong to one master range themselves spontaneously in a circular form, and lie down on their four legs; so that, by loosing a cord which binds the bales, they gently fall down on each side of the animal. When the time of loading arrives, the camels come and lie down between the bales, and, after they are fixed, rise softly with their load. This exercise they perform in a short time, and without the smallest trouble or noise.—*Voyage de Tavernier.*

The camels rejoice at the harmonious sound of the voice, or of some instrument. The Arabs use timbrels, because whipping does not make the animals advance. But music, and particularly that of the human voice, animates and gives them courage.—*Voyage d'Olearius.*

When their conductor wants to make his camels perform extraordinary journeys, instead of chastising, he encourages them with a song; and though they had formerly stopped, and refused to proceed farther, they now go on chearfully, and quicker than a horse when pushed with a spur.—*L'Afrique de Marmol.*

It is remarkable that the camels learn to march by a kind of singing; for they proceed quickly or slowly according to the sound of the voice. In the same manner, when their masters want an extraordinary journey performed, they know the tunes which the animals love best to hear.—*Voyage de Chardin.*]

The callosities and tumours on the breast and legs, the contusions and wounds of the skin, the complete falling off of the hair, hunger, thirst, and meagerness, are not the only inconveniences to which these animals are subjected: to suffer all these evils they are prepared by castration, which is a misfortune greater than any other they are obliged to undergo. One male only is left for eight or ten females; and the labouring camels are generally geldings. They are unquestionably weaker than unmutilated males; but they are more tractable, and at all seasons ready for service. While the former are not only unmanageable, but almost furious, during the rutting season, which last forty days, and returns annually in the spring. It is then said that they foam continually, and that one or two red vesicles, as large as a hog's bladder, issue from their mouths. In this season they eat little, attack and bite animals, and even their own masters, to whom at all other times they are very submisssive.

[The male camels, which in all other seasons are extremely gentle and tractable, become furious in the spring, which is the time of their copulating. Like the cats, the camels generally perform this operation during the night. The sheath of their penis then lengthens, as happens to all animals which lie much on their bellies. At all other times it is more contracted and inclined backward, that they may discharge their urine with more ease.—*Shaw's Travels.*

In the month of February the camels come in season, and the males are so furious, that they foam incessantly at the mouth.—*Voyage de la Boulaie-le-Gouz.*

When the camel is in season, he continues forty days without eating or drinking; and he is then so furious, that unless prevented he bites every person who comes near him. Wherever he bites he carries off the piece; and from his mouth there issues a white foam, accompanied with two bladders, which are large and blown up like the bladder of a hog.—*Voyage de Tavernier.*

The camels, when in season, live forty-two days without food.—*Relation de Thevenot.*

In the rutting season, which lasts five or six weeks, the camel eats much less than at any other time.—*Voyage de Chardin.*]

Their mode of copulating differs from that of all other quadrupeds; for the female, instead of standing, lies down on her knees, and receives the male in the same position that she reposes, or is loaded. This posture, to which the animals are early accustomed, becomes natural, since they assume it spontaneously in coition.

[When the camels copulate, the female lies down in the same manner as when she is about to be loaded. Some of them go thirteen months with young.—*Relation de Thevenot.*

The female receives the male lying on her belly.—*Voyage de Jean Ovington.*

It is remarkable, that when these animals copulate, the females lie on their bellies in the same manner as when they are loading. The time of their gestation is from eleven to twelve months.—*Voyage de Chardin.*

It is true that the females go with young twelve months: but those who assert, that during the time of coition, the male turns his crupper to the female are deceived. This error proceeds from the circumstance of his discharging his urine backward, by placing the penis between the two hind legs. But in copulating the female lies on her belly, and receives the male in that position.—*Voyage d'Olearius.*]

The time of gestation is near twelve months, and like all large quadrupeds the females bring forth only one at a birth. Her milk is copious and thick; and when mixed with a large quantity of water, affords an excellent nourishment to men. The females are not obliged to labour, but are allowed to pasture and produce at full liberty. The advantages derived from their produce and their milk are perhaps superior to what could be drawn from their work. In some places, however, most of the females are castrated, in order to fit them for labour; and it is alledged, that this operation, instead of diminishing, augments their strength, vigour, and plumpness. In general, the fatter camels are, they are the more capable of enduring great fatigue. Their bunches seem to proceed from a redundance of nourishment; for during long journeys, in which their conductor is obliged to husband their food, and where they often suffer much hunger and thirst, these bunches gradually diminish, and become so flat, that the place where they were is only perceptible by the length of the hair, which is always longer on these parts than on the rest of the back. The meagerness of the body augments in proportion as the bunches decrease. The Moors, who transport all articles of merchandise from Barbary and Numidia, as far as Æthiopia, set out with their camels well laden, and when they are very fat and vigorous; and bring back the same animals so meagre, that they commonly sell at a low price to the Arabs of the Desert to be again fattened.

[When the camels begin their journey, it is necessary that they should be fat; for when this animal has travelled forty or fifty days without having barley to eat, the fat of the bunches begins to diminish, then that of the belly, and, lastly, that of the limbs; after which he is no longer able to carry his load. The caravans of Africa, which travel to Æthiopia, never think of bringing back their camels; because they transport no heavy goods from that country; and when they arrive, they sell their meagre animals.—*L'Afrique de Marmol.*]

We are told by the ancients, that camels are in a condition for propagating at the age of three years. This assertion is suspicious; for in three years they have not acquired one half of their growth. The penis of the male, like that of the bull, is very long and very slender. During erection it stretches forward, like that of all other quadrupeds; but in its ordinary state the sheath is drawn backward, and the urine is discharged from between the hind legs; so that both males and females urine in the same manner. The young camel sucks his mother twelve months; but when designed to be trained, in order to render him strong and robust in the chase, he is allowed to suck and pasture at freedom during the first years, and is not loaded, or made to perform any labour, till he is four years of age. He generally lives forty and sometimes fifty years, and the duration of his life is thus proportioned to the time of his growth. There is no foundation for what has been advanced by some authors, that he lives one hundred years.

By considering, under one point of view, all the qualities of this animal, and all the advantages derived from him, it must be acknowledged that he is the most useful creature which was ever subjected to the service of man. Gold and silk constitute not the true riches of the east. The camel is the genuine treasure of Asia. He is more valuable than the elephant; for he may be said to perform an equal quantity of labour at a twentieth part of the expence. Besides, the whole species are subjected to man, who propagates and multiplies them at pleasure. But he has no such dominion over the elephants, whom he cannot multiply, and the individuals of which he conquers with great labour and difficulty. The camel is not only more valuable than the elephant, but he is perhaps equal in utility to the horse, the ass, and the ox, when their powers are united. He carries as much as two mules, though he eats as little, and feeds upon herbs equally coarse, as the ass. The female furnishes milk longer than the cow. The flesh of young camels is as good and wholesome as veal. Their hair is finer and more in request than the best wool. Even their excrements are useful; for sal ammoniac is made of their urine, and their dung serves for litter to themselves, as well as to horses, with which people frequently travel in countries where no hay or straw can be had. In fine, their dung makes excellent fewel. It burns freely, gives as clear and nearly as hot a flame as dry wood, and is of great use in the deserts, where not a tree is to be found, and where, for want of combustible materials, fire is as scarce as water.

SUPPLEMENT.

Having little to add to what has been said with regard to the camel and dromedary, we shall content ourselves with quoting a passage from M. Niebuhr's description of Arabia.

'In the country of Iman most of the camels are of a 'middle stature, and of a bright brown colour; some 'of them, however, are large, heavy, and of a deep 'brown colour. When about to copulate the female 'lies down on her legs; and her fore legs are tied 'to prevent her from rising. The male sits on his

'posteriors like a dog, with his two fore feet resting on 'the ground. He seems to be colder and more indif- 'ferent than any other animal; for he often requires to 'be teazed a long time before the ardour of love is 'excited. When the operation is finished, the female is 'suddenly raised and forced to walk. The same thing, 'it is said, takes place in Mesopotamia, Natolia, and 'probably every where else.'

I remarked that camels had been transported to the Canaries, Antilles, and Peru; but that they had not succeeded in any part of the New World. Dr. Brown, in his history of Jamaica, affirms, that he saw dromedaries there, which the English in former times had transported thither in great numbers, and that, though they still subsist, they are of little use; because the inhabitants are ignorant of the proper manner of feeding and treating these animals. They, however, multiply in all these climates, and I doubt not but they might produce even in France. We see from the Gazette of June 9, 1775, that M. Brinkenof, having made a male and female camel copulate in his territories near Berlin, obtained, on the 24th day of March, 1775, after a period of twelve months, a young camel, which was healthy and vigorous. This fact confirms what I said concerning the production of dromedaries and camels at Dresden; and I am persuaded, that if we had Arabian servants, who know how to manage these animals, we might soon render this species domestic, which I consider as the most useful of all quadrupeds.

THE BUFFALO, THE BONASUS, THE URUS, THE BISON, AND THE ZEBU.

THE buffalo, though now common in Greece, and domestic in Italy, was unknown both to the ancient Greeks and Romans; for he has no name in the languages of these people. Even the word *buffalo* indicates a foreign origin; for it has no root either in Greek or Latin. In a word, this animal is a native of the warm regions of Africa and the Indies, and was not transported and naturalized in Italy till about the seventh century. The moderns have improperly applied to him the name *bubalus*, which indeed denotes an African animal, but very different from the buffalo, as might be shown from many passages of ancient authors. If the bubalus were to be referred to a particular genus, he should rather belong to that of the antilope than to that of the ox. Belon, having seen at Cairo a small ox with a bunch on his back, which differed from the buffalo and common ox, imagined that it might be the bubalus of the ancients. But if he had carefully compared the characters given by the ancients to the bubalus, with those of this small ox, he would have discovered his error. Besides, we are enabled to speak of it with certainty; for we have seen it alive; and after comparing the description we have given of it with that of Belon, we cannot hesitate in pronouncing it to be the same animal. It was exhibited at the fair of Paris in the year 1752, under the name of *zebu*, which we have adopted to denote this animal, because it is a particular race of the ox, and not a species of the buffalo or bubalus.

Aristotle, when treating of oxen, mentions not the common ox, but only remarks, that among the *Arachotas* in India there are wild oxen, which differ from the domestic kind as much as the wild boar differs from the common hog. But in another place, he gives a description of a wild ox in Pœonia, a province bordering on Macedonia, which he calls *bonasus*. Thus the common ox and the bonasus are the only animals of this kind mentioned by Aristotle; and what is singular, the bonasus, though fully described by this great philosopher, was unknown to the Greek and Latin naturalists who wrote after him; for they have all copied him verbatim on this subject. So that at present we only know the name *bonasus*, without being able to distinguish the animal to which it ought to be applied. If we consider, however, that Aristotle, when speaking of the wild oxen of temperate climates, mentions the bonasus only, and that, on the contrary, the Greeks and Latins of after ages take no notice of the bonasus, but point out these wild oxen under the appellations of *urus* and *bison*, we will be induced to think that the bonasus must be either the one or the other of these animals; and, indeed, by comparing what Aristotle has said of the bonasus with what we know concerning the bison, it is probable that these two names denote the same animal. The urus is first mentioned by Julius Cæsar; Pliny and Pausanias are also the first who announced the bison. From the time of Pliny the name *bubalus* has been indiscriminately applied to the urus or the bison. Confusion always augments as time advances. To the bonasus, bubalus, urus, and bison, have been added the *catopleba*, the *thur*, the bubalus of Belon, the Scottish and American bisons;

and all our naturalists have made as many different species as they have found names. Here truth is so environed with darkness and error, that it will be difficult to elucidate this part of natural history, which the contrariety of evidence, the variety of descriptions, the multiplicity of denominations, the diversity of places, the differences of languages, and the obscurity of time, seemed to have condemned to perpetual darkness.

I shall first give my opinion on this subject, and afterwards produce the proofs of it.

1. The animal we call *buffalo* was unknown to the ancients.

2. The buffalo, now domestic in Europe, is the same as the domestic or wild buffalo of India and Africa.

3. The *bubalus* of the Greeks and Romans is neither the buffalo nor the small ox of Belon, but the animal described in the Memoirs of the *Barbary cow*, and which we call *bubalus*.

4. The small ox of Belon, which we have seen, and distinguised by the name *zebu*, is only a variety of the common ox.

5. The *bonasus* of Aristotle is the same animal with the *bison* of the Latins.

6. The *bison* of America might proceed originally from the European bison.

7. The *urus* or *aurochs* is the same animal with the common bull in its natural and wild state.

8. The bison differs from the aurochs by accidental varieties only; and consequently it is, as well as the aurochs, of the same species with the domestic ox; so that I think I shall be able to reduce all the denominations, and all the pretended species, both of ancient and modern naturalists, to three, namely, the ox, the buffalo, and the bubalus.

Some of the propositions I am about to lay down will, I doubt not, appear to be mere assertions, particularly to those who have been accustomed to study the nomenclators of animals, or have attempted to give lists of them. There are none of these assertions, however, which I am not able to prove. But before entering into critical discussions, each of which requires particular propositions, I shall relate the facts and remarks which led me into this research; and as they have satisfied myself, I hope they will be equally satisfactory to others.

Domestic animals differ, in many respects, from wild animals. Their nature, their size, and their form, are more fluctuating, and subject to greater changes, especially in the external parts of the body. The influence of climate, which acts powerfully upon all nature, exerts itself with greater efficacy upon captive than upon free animals. Food prepared by the hand of man, which is often ill chosen, and sparingly administered, joined to the inclemency of a foreign sky, produce, in the progress of time, alterations so deeply engraven that they become constant, and are transmitted to posterity. I pretend not to maintain, that this general cause of change is so powerful as to alter essentially the nature of beings whose constitution is so permanently fixed as that of animals. But it transforms and masks their external appearance; it annihilates some parts, and gives rise to others; it paints them with various colours; and by its action on the temperament of the body, it has an influence on the dispositions, instincts, and other internal qualities. The modification of a single part, in a machine so perfect as that of an animal body, is sufficient to make the whole feel the effects of the alteration. It is for this reason that our domestic animals differ nearly as much in dispositions and instincts, as in figure, from those which enjoy their natural state of freedom. Of this the sheep affords a striking example. This species, in its present condition, could not exist without the care and defence of man: it is also much changed, and very inferior to its original species. But not to depart from our chief object, we see how many alterations the ox has undergone, from the combined effects of climate, food, and management, in a wild and in a domestic state.

The bunch which some oxen carry between their shoulders, both in a domestic and wild state, is the most general and most remarkable variety. This race of oxen are denominated *bisons;* and it has been imagined till now that they were of a different species from the common ox. But as we are certain that these animals produce with the common kind, and that the bunch diminishes from the first generation, and disappears in the second or third, it is evident, that this bunch is only an accidental and variable character, which prevents not the bunched ox from belonging to the same species with our ox. Now in the desert parts of Europe there were in ancient times wild oxen, some of them with bunches, and others without bunches. Hence this variety seems to be natural, and to proceed from the abundance and more substantial quality of the food; for we remarked, when treating of the camels, that when meagre and ill fed, they have not even the least vestige of a bunch. The ox without a bunch was called *vrochs* and *turochs* in the language of the Germans, and in the same language the bunched ox was called *visen*. The Romans, who knew neither of these wild oxen till they saw them in Germany, adopted their German names. From *vrochs* they made *vrus*, and from *visen*, *bison*. They never imagined that the wild ox described by Aristotle, under the name of *bonasus*, could be one or other of these oxen whose names they had Latinized.

The length of the hair is another difference between the aurochs and the bison. The neck, the shoulders, and the throat of the bison, are covered with very long hair. But in the aurochs all these parts are covered with short hair, similar to that on the rest of the body, except

the front, which is covered with crisped hair. This difference of the hair, however, is still more accidental than that of the bunch, and depends likewise on the food and the climate, as we have proved under the articles goat, sheep, dog, cat, rabbit, &c. Thus, neither the bunch, nor the difference in the length of the hair, are specific characters, but accidental varieties only.

A more extensive variety than the other two arises from the figure of the horns; to which character naturalists have ascribed more importance than it deserves. They have not considered, that in our domestic cattle, the figure, the size, the position, the direction, and even the number of the horns, vary so greatly, that it is impossible to ascertain what is the real model of nature. In some cows the horns are much crooked, and hang so low as to be almost pendulous; in others they are more erect, longer, and more elevated. There are entire races of ewes with sometimes two, sometimes four horns; and there are races of cows without horns. These external, or as they may be called, accessory parts of the body, are as fluctuating as the colours of the hair, which in domestic animals are varied and combined in every possible manner. This difference in the figure and direction of the horns, which is so frequent, ought not, therefore, to be regarded as a distinctive character of species. It is, however, the only character which our naturalists have adopted in their species; and as Aristotle, in his description of the bonasus, says, that its horns bended inwards, they have, from this consideration alone, and without ever having seen the individual, separated it from the rest, and made it a distinct species. In this variation of the horns of domestic animals, we have confined our remarks to cows and ewes; because the females are always more numerous than the males; and we every where see thirty cows or ewes for one bull or ram.

The mutilation of animals by castration seems to injure the individual only, and to have no influence on the species. It is certain, however, that this practice restrains nature on the one hand, and weakens her on the other. A single male, obliged to serve thirty or forty females, must be enfeebled; besides, the ardour of love is unequal. It is cool in the male, who exerts himself beyond the bounds of nature, and too ardent in the female, whose enjoyment is limited to an instant. Of course the offspring must be chiefly tinctured with the feminine qualities; more females will be produced than males; and even the males will partake more of the mother than the father. This is unquestionably the reason why more girls than boys are brought forth in those countries where men have a great number of wives. On the contrary, in all countries where the men are allowed but one wife, more males are produced than females. It is true, that in domestic animals, the finest males are selected to become the fathers of an offspring so numerous. The first productions from these males will be strong and vigorous. But in proportion to the number of copies taken from the same mould, the original impression of nature will be deformed, or at least rendered less perfect. The race must, therefore, degenerate, and become more feeble. This perhaps is the reason why more monsters are produced among domestic than wild animals, where the number of males is equal to that of the females. Besides, when one male is obliged to serve many females, they have not the liberty of following their own taste. They are deprived of that gaiety, and those soft emotions, which proceed from spontaneous pleasures. The fire of their love is half extinguished; and they languish, waiting for the cold approaches of a male whom they have not selected, who is often not accommodated to them, and who always flatters less than one that is obliged to caress, in order to obtain a preference. These melancholy and tasteless amours must give rise to productions equally dismal and insipid; beings who never have that courage, spirit, and strength, which nature can only bestow on each species, by leaving all the individuals in full possession of their powers, and, above all, of the liberty of choice in the intermixture of the sexes. We learn from the example of horses, that crossed races are always the most beautiful. We ought not, therefore, to confine our female cattle to a single male of their own country, who already has too much resemblance to his mother, and who, consequently, instead of improving, continues to degrade the species. Man in this article prefers his convenience to every other advantage. We never think of improving or of embellishing nature; but we submit to her operations, that we may enjoy her in a more arbitrary manner. The males constitute the glory of each species. They have more courage, fire, and obstinacy. A great number of males in our flocks would render them less tractable, and more difficult to manage. In those slaves of the most abject kind, it is even necessary to depress every head that offers to exalt itself.

To these causes of degeneration in domestic animals we must still add another, which alone has produced more changes than all the combined force of the others; I mean, the constant transportation of those animals from climate to climate. The ox, the sheep, the goat, have been carried to every habitable part of the globe. These species have been subjected to the influence of every climate, and have received impressions from every soil and every sky; so that it has become extremely difficult, amidst the number of changes they have undergone, to recognise those which are least removed from the prototype of nature.

Having pointed out the general causes of the varieties among domestic animals, I shall now exhibit the particular proofs of what I advanced concerning the oxen and buffalos.

1. I remarked, *That the animal we now know by the name of buffalo was unknown to the ancient Greeks and Romans.* This position is evident; for in none of their authors is there any description, or even name, which can be applied to the buffalo. Besides, we learn from the annals of Italy, that the first buffalo was transported thither about the end of the sixth century.

2. *The buffalo, now domestic in Europe, is the same with the wild or domestic buffalo of India and Africa.* Of this no other proof is necessary than a comparison of our description of the buffalo, which was made from the live animal, with the notices given by travellers of the buffalos in Persia, Mogul, Bengal, Egypt, Guinea, and the Cape of Good Hope. It is easy to perceive, that in all these countries this animal is the same, and differs from our buffalo only by very slight varieties.

3. *The bubalus of the Greeks and Latins is neither the buffalo, nor the small ox of Belon, but the animal described in the Memoirs of the Academy of Sciences, under the name of the Barbary cow.* The following facts will prove this position. Aristotle ranks the bubalus with the stag and fallow deer, and not with the ox. In another place he mentions the bubalus along with the roe deer; and remarks, that he makes a bad defence with his horns, and that he flies from all ferocious animals. Pliny, speaking of the wild oxen of Germany, says, that it is only from ignorance that the vulgar give the name of *bubalus* to these oxen; for the bubalus is an African animal, which resembles in some measure a calf or a stag. Hence the bubalus is a timid creature, his horns are useless to him, and to avoid the assaults of ferocious animals he has no other resource but flight; of course, he is nimble, and is related by his figure both to the cow and the stag. All these characters, none of which apply to the buffalo, are combined in the animal whose figure was sent by Horatius-Fontana to Aldrovandus, and of which the gentlemen of the Academy have likewise given a figure and description, under the name of the *Barbary cow;* and they agree with me in thinking, that it is the bubalus of the ancients. The zebu, or small ox of Belon, has none of the characters of the bubalus; for the zebu differs as much from the bubalus as the ox from the antilope; and Belon is the only naturalist who regarded this small ox as the bubalus of the ancients.

4. *The small ox of Belon is only a variety of the common ox.* This position may be easily proved by simply referring to the figure of the animal given by Belon, Prosper Alpinus, and Edwards, and to our own description of it. We have seen it alive: its conductor told us, that it came from Africa, where it was called *zebu;* that it was domestic, and was used for riding. It is indeed a very mild and even a caressing animal. Its figure, though thick and squat, is agreeable. It has, however, so perfect a resemblance to the ox, that I can give no better idea of it than by remarking, that if a handsome bull were viewed through a glass which diminished objects one half, this contracted figure would be that of the zebu.

[This small ox has a perfect resemblance to that of Belon. Its crupper is round, and plumper than that of the common ox. It is so gentle and familiar that it licks the hand like a dog, and caresses every person who approaches. It is a very beautiful animal; and its intelligence seems to be equal to its docility. We were informed by its conductor, that it was brought from Africa, and that its age was twenty-one months. Its colour was white, mixed with yellow and a little red. All the legs were white. The hair on the spine of the back, for about a foot wide, is black, and the tail of the same colour. In the middle of this black band, there is on the crupper a small white streak, the hairs of which stand erect like bristles. It had no mane, and there was very little hair on the tuft. The hair of the body is very smooth and short. It was five feet seven inches in length, from the end of the muzzle to the origin of the tail, five feet one inch in circumference behind the fore legs, five feet six inches at the middle of the body, and five feet one inch above the hind legs. The circumference of the head, taken before the horns, was two feet ten inches, and that of the muzzle, taken behind the nostrils, was one foot three inches. The fissure of the mouth, when shut, was eleven inches. The nostrils were two inches long by one broad; and from the end of the muzzle to the eye measured ten inches. The eyes were distant from each other about six inches; and from their posterior angle, to the aperture of the ears, measured four inches. The ears were situated behind and a little to one side of the horns, and were near seven inches long, and nine inches in circumference at the base. The distance between the horns was little more than four inches; they were one foot two inches in length, six inches in circumference at the base, and at half an inch from the points only an inch and a half. They were of the ordinary colour of horn, and black near the extremities, which were distant from each other one foot seven inches. The bunch, which consisted entirely of flesh, was seven inches in perpendicular height. The colour of the hair which covered it was blackish, and an inch and a half long. The tail, to the end of the vertebræ, was little more than two feet long; but including the hair, which hangs down to the ground, it was two feet ten inches and a half. The longest hairs of the tail measured one foot three inches. The testicles were a foot and a half distant from the anus. It had four paps, situated like those of the bull.]

This description corresponds very well with that given by Belon, which I have inserted, that the reader may have an opportunity of comparing them.

[This is a very small bull; it is thick, fat, smooth,

and well shaped. It was already old, though its body was not so large as that of a stag; but it was more squat, and thicker than a roebuck, and so neat and compact in all its members, that it was extremely agreeable to behold. Its feet resembled those of the ox; and its legs were short and squat. Its neck is thick and short, and the dewlap very small. It has the head of an ox; and the horns rise from a bone on the top of the head. They are black, much notched, like those of the gazelle, or Barbary antilope, and formed like a crescent. It has the ears of a cow; its shoulders are plump, and a little elevated; its tail is long, and covered with black hair. It has the appearance of an ox, only it is not so tall. Belon adds, that this small ox was brought to Cairo from Azamia, a province of Asia, and that it is also found in Africa.—*Obs. de Belon.*]

Prosper Alpinus, who describes this animal, and gives a figure of it, says that it is found in Egypt. His description agrees with mine, and also with Belon's. The only differences between the three are in the colour of the horns and hair. The zebu of Belon was yellow on the belly, brown on the back, and had black horns. That of Prosper Alpinus was red, marked with small spots, with horns of the ordinary colour. Ours was of a pale yellow, almost black on the back, with horns of the same colour as those of a common ox. In the figures of Belon and Prosper Alpinus, the bunch on the back is not sufficiently marked. The opposite error takes place in the figure which Mr. Edwards has lately given of this animal, from a drawing communicated to him by Sir Hans Sloane; for the bunch is too large. Besides, the figure is incomplete; for it seems to have been drawn from a very young animal, whose horns were only beginning to shoot. It came, says Mr. Edwards, from the East Indies, where these small oxen are used as we do horses. From all these hints, and likewise from the varieties in the colour, and the natural mildness of this animal, it is apparent that it belongs to the bunched race of oxen, and has derived its origin from a domestic state, in which the smallest individuals have been chosen for a breed; for in general, we find, that the bunched oxen in a domestic state, like our own domestic kind, are smaller than those in a wild state. These facts shall afterwards be fully confirmed by the testimonies of travellers.

5. *The bonasus of Aristotle is the same animal with the bison of the Latins.* This proposition cannot be proved without a critical discussion, with which I shall not fatigue the reader. Gessner, who was a man of literature as well as a naturalist, and who thought as I do, that the bonasus might probably be the bison, has examined the notices given of the bonasus by Aristotle with more care than any other person; he has, at the same time, corrected several erroneous expressions in Theodore Gaza's translation; which errors, however, have been servilely copied by all the succeeding naturalists. From these assistances, and by rejecting from the remarks of Aristotle whatever is obscure, contradictory, or fabulous, the following seems to be the result. The bonasus is a wild ox of Pœonia, and is equally large, and of the same figure with the domestic ox. But his neck, from the shoulders to the eyes, is covered with long hair, which is softer than the mane of a horse. He has the voice of an ox. His horns are short, and bended round the ears. His legs are covered with long hair, as soft as wool; and his tail is short in proportion to his size, though in every other respect it is similar to that of the ox. Like the bull he has the habit of raising the dust with his feet. His skin his hard, and his flesh tender and good. From these characters, which are all that can be collected from the writings of Aristotle, we see how nearly the bonasus approaches to the bison. Every article indeed corresponds, except the form of the horns, which, as was formerly remarked, varies considerably in animals that belong to the same species. We have seen horns bended in the same manner, which were taken from a bunched ox of Africa; and we shall afterwards prove that this bunched ox is nothing but the bison. What I now advance may likewise be confirmed by the testimonies of ancient authors. Aristotle calls the bonasus a Pœonian ox: and Pausanias, speaking of the Pœonian bull, says, in two different places, that these bulls are bisons. He likewise tells us, that the Pœonian bulls, which he saw at the Roman shews, had very long hair on the breast and about the jaws. Lastly, Julius Cæsar, Pliny, Pausanias, Solinus, &c. when speaking of wild oxen, mention the aurochs and the bison, but take no notice of the bonasus. We must, therefore, suppose, that in the course of four or five centuries the species of bonasus has been lost, unless we allow that the terms *bonasus* and *bison* denote only the same animal.

6. *The bison of America might proceed originally from the European bison.* The foundation of this opinion has already been laid in our dissertation on the animals peculiar to the two continents. It was from the experiments of M. de la Nux that we derived much information on this subject. From him we learn, that the bisons, or bunched oxen of India and Africa, produce with the European bulls and cows, and that the bunch is only an accidental character, which diminishes in the first generation, and totally disappears in the second or third. Since the Indian bisons are of the same species with our oxen, and of course have the same origin, is it not natural to extend this origin to the American bison? In support of this supposition every thing seems to concur. The bison appears to be a native of cold and temperate regions. His name is derived from the German language. The ancients tell us, that he was found in that part of Germany which borders upon Scythia; and there are still bisons in the northern parts of

Germany, in Poland, and in Scotland. Hence they might pass to America, or come from that country, as they are animals common to both continents. The only difference between the European and American bisons is, that the latter are smaller. But even this difference is a farther proof that they belong to the same species; for it was formerly remarked, that in general both the domestic and wild animals which have spontaneously passed, or been transported, into America, have uniformly diminished in size. Besides, all the characters, not excepting the bunch and the long hair on the anterior parts of the body, are the same in the American and European bisons. Hence these animals must be regarded as not only of the same species, but as proceeding from the same race.

[Several persons of note have reared small oxen and wild cows, which are found in Carolina, and in other countries as far south as Pensylvania. These small oxen are tamed; but they still retain so much of their natural ferocity, that they pierce through every hedge which opposes their passage. Their heads are so strong that they overturn the pallisades of their inclosures to come at the cultivated fields, where they do much mischief; and as soon as a passage is opened they are followed by the whole flock of domestic cattle. These two kinds couple together, and have given rise to an intermediate kind.—*Voyage de Pierre Kalm.*]

7. *The urus, or aurochs, is the same animal with the common bull in its natural and wild state.* This position is evident from the figure of the aurochs, and its whole habit of body, which are perfectly similar to those of our domestic bull. The aurochs, like every other animal that enjoys liberty, is only larger and stronger. The aurochs is still found in some northern provinces; the young aurochs have sometimes been carried off from their mothers, and after being reared to maturity they produced with our domestic bulls and cows. Hence these animals must unquestionably belong to the same species.

8. *Lastly, the bison differs from the aurochs by accidental varieties only; and, consequently, it is, as well as the aurochs, of the same species with the domestic ox.* The bunch, the length and quality of the hair, and the figure of the horns, are the sole characters by which the bison can be distinguished from the aurochs. But we have seen the bunched ox produce with the common domestic kind; we likewise know, that the length and quality of the hair, in all animals, depend on the nature of the climate; and we have remarked, that in the ox, sheep, and goat, the form of the horns is various and fluctuating. These differences, therefore, are by no means sufficient to constitute two distinct species: and since our domestic cattle produce with the bunched Indian oxen, they would likewise undoubtedly produce with the bison or bunched ox of Europe. Among the almost innumerable varieties of these animals in different climates, there are two primitive races, both of which have long continued in a natural state, the bison or bunched ox, and the aurochs or ox without a bunch. These races have subsisted either in a wild or domestic state, and have been diffused, or rather transported by men, into every climate of the globe. All the domestic oxen without bunches have proceeded originally from the aurochs, and all the bunched oxen have been derived from the bison. To obtain a just idea of these varieties, we shall give an enumeration of them as they exist in different parts of the world.

To begin with the north of Europe; the small bulls and cows of Iceland, though they belong to the same race with our oxen, are deprived of horns. The magnitude of these animals depends more on the abundance and quality of their pasture than on the nature of the climate. The Dutch bring meagre cattle from Denmark, which fatten prodigiously in their rich meadows, and give a great quantity of milk. These Danish cattle are much larger than ours. The cows and bulls of the Ukraine, where the pasture is excellent, are reckoned to be the largest in Europe, and are of the same race with the common kind. In Switzerland, where the tops of the first mountains are covered with verdure and flowers, and are solely destined for the feeding of cattle, the oxen are nearly double the size of those in France, where they are commonly fed upon gross herbage, which is despised by the horses. During winter bad hay and leaves are the common food of our oxen; and in spring, when they stand in need of being recruited, they are excluded from the meadows. Hence they suffer more in spring than in winter; for they then hardly receive any thing in the stable, but are conducted into the highways, into fallow grounds, or into the woods, and are always kept at a distance from fertile land; so that they are more fatigued than nourished. Lastly, in summer, they are permitted to go into the meadows, which are then eat up, and parched with drought. During the whole year, therefore, these animals are never sufficiently nourished, nor receive food agreeable to their nature. This is the sole cause which renders them weak and of a small size; for in Spain, and in some districts of our provinces, where the pasture is good, and reserved for oxen alone, they are much larger and stronger.

In Barbary, and most parts of Africa, where the lands are dry, and the pasture poor, the oxen are still smaller, the cows give much less milk than ours, and most of them lose their milk with their calves. The same remark applies to some parts of Persia, of Lower Æthiopia, and of Great Tartary; while in the same countries, and at no great distances, as in Calmuck Tartary, in Upper Æthiopia, and in Abyssinia, are oxen of a prodigious size. Hence this difference depends more on the quantity of food than on the temperature of the climate. In

the northern and temperate, as well as in the warm regions, we find, at very inconsiderable distances, large or small oxen, according to the quantity or quality of the pasture they have to feed upon.

[The riches of the Abyssinians consist chiefly in cows. The horns of the oxen are so large that they hold twenty pints. They are used by the Abyssinians for pitchers and bottles.—*Voyage d'Abyssinie du P. Lobo.*

The oxen which draw coaches in Surat are white, of a good size, and have two bunches, like those of certain camels. They run and gallop like horses, and are garnished with splendid housing, and a number of small bells fixed to their necks. When the animals are in motion, the bells are heard at a considerable distance, and their noise in the streets is very agreeable. These coaches are used not only in the cities of India, but in travelling through the country.—*Voyage de Pietro della Valle.*

The carriages of the Mogul are a kind of coaches with two wheels. They are drawn by oxen, which, though naturally heavy and slow in their movements, acquire by long habit such a dexterity in drawing these carriages, that no other animal can outrun them. Most of these oxen are very large, and have a bunch between their shoulders, which rises to the height of six inches.—*Voyage de Jean Ovington.*

The oxen of Persia are like our own, except on the frontiers of India, where they have a bunch on the back. Few oxen are eaten in this country: they are reared chiefly for labouring the ground, or for carrying burdens. Those employed in carrying loads are shod, on account of the stony mountains they have to pass.—*Voyage de Chardin.*

The oxen of Bengal have a kind of bunch on the back. We found them as fat and as well tasted as in any other country. The largest and best sell at two rixdollars only.—*Voyage de la Compagnie des Indes d'Hollande.*

The oxen of Guzarat are shaped like curs, except that they have a bunch between the shoulders.—*Voyage de Mandelslo.*]

The race of aurochs, or of the ox without a bunch, occupies the frozen and temperate zones, and is not much diffused over the southern regions. The race of the bison, or bunched ox, on the contrary, occupies all the warm climates. In the whole continent of India, in the eastern and southern islands, throughout all the regions of Africa, from Mount Atlas to the Cape of Good Hope, there are almost no oxen without bunches. It even appears that this race, which is diffused over all the warm countries, has several advantages over the other; for like the bison, from which they have proceeded, these bunched oxen have softer and more glossy hair than ours, whose hair, like that of the aurochs, is hard, and thinly spread over the body. They are likewise swifter, more proper for supplying the place of the horse, and at the same time not so stupid and indolent as our oxen. They are more tractable and intelligent, and have more of those relative feelings from which advantage may be derived. They are likewise treated with more care than our best horses.

[In the island of Madagascar an immense number of oxen are reared: they are very different from those of Europe, each of them having a bunch of fat on their backs, in the form of a wen, which has made some authors alledge that they are suckled by camels. There are three kinds, namely, those which have horns, those which have pendulous horns attached to the skin, and those which have no horns, but only a small osseous eminence in the middle of their front, covered with skin. The last kind fail not, however, to combat other bulls by striking their bellies with their heads. They all run like our stags, and have longer legs than those of Europe.—*Voyage de Flacourt.*

The oxen in the island of Johanna, near the Mosambique coast, differ from ours. They have a fleshy crescent between the neck and back. This portion of flesh is preferred to the tongue, and is as well tasted as the marrow.—*Grosse's Travels.*

The oxen of Aguada Sanbras are likewise larger than those of Spain. They have bunches, but no horns.—*Premier Voyage des Hollandois aux Indes Orientales.*

The Moors have numerous flocks on the banks of the Niger. Their oxen are much thicker, and have longer legs than those of Europe. They are remarkable for a large fleshy wen, which rises between their shoulders more than a foot high. This wen is a delicious morsel.—*Voyage au Senegal.*

At the Cape of Good Hope there are three kinds of oxen, which are all large, and very swift. Some of them have a bunch on the back; others have pendulous horns; and others have horns like those of the European kind.—*Voyage de F. le Guat.*

As the oxen in India are perfectly gentle, many people travel on them as we do on horses. Their common pace is soft. Instead of a bit a small cord is passed through the cartilage of their nostrils, which is tied to a larger cord, and serves as a bridle; and this bridle is fixed to a bunch on the fore part of the back, which is wanting in our oxen. They are saddled like horses, and when pushed move as briskly. These animals are used in most parts of India; and no other are employed in drawing carts and chariots. They are fixed to the end of the beam by a long yoke, which is placed on the necks of the two oxen; and the driver holds the rope to which the cord that passes through the nostrils is tied.—*Relation de Thevenot.*

This Indian prince was seated on a chariot drawn by two white oxen with short necks, and bunches on their shoulders; but they were as swift and alert as our horses.—*Voyage d'Olearius.*

The two oxen which were yoked to my coach cost near 600 rupees. This price need not astonish the reader; for some of these oxen are very strong, and perform journeys of sixty days at the rate of from twelve to fifteen leagues a-day, and always at a trot. When one half of the day's journey is finished, each of them is supplied with two or three balls of the size of a penny loaf, made of flour kneaded with butter and black sugar; and at night their common food is chick-peas bruised, and steeped for half an hour in water.—*Voyage de Tavernier.*

Some of these oxen follow the horses at a smart trot. The smallest are the most nimble. The Gentoos, and particularly the Banians and merchants of Surat, use these oxen for drawing their carriages. It is remarkable, that notwithstanding their veneration for these animals the people scruple not to employ them in such laborious services.—*Grosse's Travels.*

In the country of Camandu in Persia there are many oxen entirely white, with small blunt horns, and bunches on their backs. They are very strong, and carry heavy burdens. When about to be loaded, they lie down on their knees like the camels, and rise again when the goods are properly fastened. To this practice they are trained by the natives.—*Description de l'Inde*, &c.

The European labourers prick their oxen with a goad in order to make them advance. But in Bengal their tails are only twisted. These animals are extremely tractable. When loading they are instructed to lie down, and to rise with the burdens on their back.—*Lettres Edif. recueil.*]

The respect the Indians entertain for these animals is so great, that it has degenerated into superstition, which is the ultimate step of blind veneration. The ox, being the most useful animal, has appeared to them to merit the greatest reverence. This venerable object they have converted into an idol, a kind of beneficent and powerful divinity; for every thing we respect must be great, and have the power of doing much good or much evil.

[The queen is attended with the ladies of fashion, and the pavement or roads through which she passes are strewed with the dung of the cows formerly mentioned. These people have such a veneration for their cows, that they are allowed to enter the king's palace, and are never stopped on their passage, wherever they choose to go. The king and all the nobles give place to these cows, as well as to the bulls and oxen, with every possible mark of respect and veneration.—*Voyage de Francois Pyrard.*]

These bunched oxen vary perhaps more than ours in the colour of the hair and the figure of their horns. The most beautiful are white, like those of Lombardy. Some of them have no horns; the horns of others are very high, and in others they are almost pendulous. It even appears that this first race of bisons, or bunched oxen, should be divided into two secondary races, the one large, and the other small, which last comprehends the zebu. Both are found nearly in the same climates, and are equally gentle and easily managed. Both have fine hair, and bunches on their backs. This bunch is only an excrescence, a fleshy wen, which is equally tender and good as the tongue of an ox. The bunches of some oxen weigh from forty to fifty pounds, and those of others are much smaller. In some the horns are prodigiously large. In the royal cabinet there are specimens of them of three feet and a half in length, and seven inches in diameter at the base. We are assured by several travellers, that they have seen horns which could contain fifteen and even twenty pints of water.

[The oxen of India are of different sizes, some large, others small, and others of a middle size. But in general they travel well, some of them making journeys of fifteen leagues a-day. Some of them are near six feet high; but these are rare. There is another kind called *dwarfs*, because they exceed not three feet in height. The latter, like the others, have a bunch on their backs, run very fast, and are used for drawing small carts. The white oxen are extremely dear. I have seen two, which belonged to the Dutch, each of which cost two hundred crowns. They were indeed very beautiful and strong; and the chariot in which they were yoked had a magnificent appearance. When the people of fashion have fine oxen they take great care of them. The tips of their horns are ornamented with copper rings. They are covered with clothes, in the same manner as horses. They are daily curried, and fed with great attention.—*Relation d'un Voyage par Thevenot.*]

Throughout all Africa the large cattle are never castrated; and this operation is not much practised in India. When the bulls are castrated, the testicles are not cut off, but compressed. Though the Indians keep a great number of these animals for drawing their carriages and ploughing the ground, they do not rear so many as we do. As in all warm countries, the cows give little milk, as the natives are unacquainted with butter or cheese, and as the flesh of the calves is not so good as in Europe, the inhabitants do not greatly multiply horned cattle. Besides, in all the southern provinces of Africa and Asia, being more thinly peopled than those of Europe, there are a number of wild oxen, which are taken when young. They tame spontaneously, and submit without resistance to all kinds of domestic labour. They become so tractable that they are managed with as much ease as horses: the voice of their master is sufficient to direct their course, and to make them obey. They are shod, curried, caressed, and supplied abundantly with the best food. These animals, when managed in this manner, appear to be different creatures from our oxen, which only know us from our bad treatment. The goad, blows, and hunger, render them stupid, refractory,

and feeble. If we had a proper knowledge of our own interest, we would treat our dependents with greater lenity. Men of inferior condition, and less civilised, seem to have a better notion than other people of the laws of equality, and of the different degrees of natural equity. The farmer's servant may be said to be the peer of his master. The horses of the Arab, and the oxen of the Hottentot, are favourite domestics, companions in exercises, assistants in every labour, and participate the habitation, the bed, and the table of their masters. Man, by this communication, is not so much degraded as these brutes are exalted and humanized. They acquire affectionateness, sensibility, and intelligence. There they perform every thing from love, which they do here from fear. They do more; for as their nature is improved by the gentleness of their education, and the perpetual attention bestowed on them, they become capable of performing actions which approach to the human powers. The Hottentots train their oxen to war, and employ them nearly in the same manner as the Indians employ the elephants. These oxen are instructed to guard the flocks, which they conduct with dexterity, and defend them from the attacks of strangers and ferocious animals. They are taught to distinguish friends from enemies, to understand signals, and to obey their master's voice. Thus the most stupid of men are the best preceptors to brutes. How does it happen that the most enlightened man, instead of managing his fellow creatures, has so much difficulty in conducting himself?

[The Hottentots have oxen which they employ successfully in their combats. These animals are called *backeleys*, from the word *backeley*, which in the Hottentot language signifies *war*. In all their armies there are considerable troops of those oxen, which are easily governed, and which are let loose by the chief when a proper opportunity occurs. They instantly dart with great impetuosity on the enemy. They strike with their horns, kick, overturn, and trample under their feet every thing that opposes their fury. Hence, if not quickly turned back, they run ferociously into the ranks, which they soon put into the utmost disorder, and thus prepare an easy victory for their masters. The manner in which these animals are trained and disciplined reflects much honour on the genius and ability of the Hottentots.—*Voyage de Cap de Bonne Esperance*, &c.

These backeleys are likewise of great use in guarding the flocks. When pasturing, at the smallest signal from the keeper, they bring back and collect the wandering animals. They also run with fury upon strangers, which makes them a great security against the attacks of the *buschies*, or robbers of cattle. Every *kraal* has at least six of these backeleys, which are chosen from among the fiercest oxen. When one of them dies, or becomes unserviceable by age, another is selected from the flock to succeed him. The choice is made by one of the oldest kraals, who is supposed to distinguish the animal that will be most easily instructed. This noviciate is associated with one of the most experienced backeleys, and he is taught to follow his companion, either by blows, or by other means. In the night they are tied together by the horns, and are likewise kept in the same situation during part of the day, till the young ox is completely trained to be a vigilant defender of the flock. These backeleys, or keepers of the flocks, know every inhabitant of the *kraal*, and show the same marks of respect for all the men, women, and children, as a dog does for those who live in his master's family. Hence these people may approach their cattle with the utmost safety; for the backeleys never do them the smallest injury. But if a stranger, and particularly an European, should use the same freedom, without being accompanied with a Hottentot, his life would be in the greatest danger. These backeleys, which pasture all around, would soon run upon him at full gallop, and if not protected by the shepherds, by fire arms, or by suddenly climbing a tree, his destruction is inevitable. In vain would he have recourse to sticks or stones: a backeley is not to be intimidated by such feeble weapons.—*Description du Cap. de Bonne Esperance.*]

Thus the bisons, or bunched oxen, are diffused over all the southern parts of Africa and Asia. They vary greatly in size, in colour, in the figure of the horns, &c. On the contrary, in all the northern regions of these two quarters of the world, and in the whole of Europe, including the adjacent islands, as far as the Azores, there are only oxen without bunches, which derive their origin from the aurochs. And as the aurochs, which is our ox in a wild state, is larger and stronger than the domestic kind, the bison, or wild ox with a bunch, is likewise stronger and larger than the Indian domestic ox. He is also sometimes smaller; but the size depends solely on the quantity of food. In Malabar, Canara, Abyssinia, and Madagascar, where the meadows are fertile and spacious, the bisons are of a prodigious size. In Africa and Arabia Petrea, where the ground is dry and sterile, the zebus or bisons are of a small size.

[The oxen of Tercera are the largest and finest in Europe. Their horns are very large. They are so gentle and tame, that from a flock consisting of more than a thousand, a single animal, upon its name being called by the proprietor, (for every individual has its peculiar name, like our dogs,) instantly runs to him.—*Voyage de la Compagnie des Indes d'Hollande.*

In the mountains of Malabar and Canara there are wild oxen so large that they approach the stature of the elephant; while the domestic oxen of the same country are small, meagre, and short lived.—*Voyage du P. Vincent Marie.*

I saw at Mascati, a town of Arabia Petrea, another species of mountain ox, with glossy hair, as white as

that of the ermine. It was so handsomely made that it rather resembled a stag than an ox. Its legs indeed were shorter; but they were fine and nimble. The neck was short. The head and tail resembled those of the common ox, but were better shaped. The horns are black, hard, straight, beautiful, about three or four palms in length, and garnished with rings, which seem as if they had been turned in a lathe.—*Voyage du P. Vincent Marie.*]

Oxen without bunches are spread all over America. They were successively transported thither by the Spaniards and other Europeans. These oxen have greatly multiplied, but have become smaller in these new territories. This species was absolutely unknown in South America. But in all the northern regions, as far as Florida, Louisiana, and even in the neighbourhood of Mexico, the bisons, or bunched oxen, were found in great numbers. These bisons, which formerly inhabited the woods of Germany, of Scotland, and other northern countries, have probably passed from the Old to the New Continent. Like all the other animals, their size has diminished in America; and according as they lived in climates more or less cold, their hair became longer or shorter. In Hudson's Bay their beard and hair are longer and more bushy than in Mexico; and in general their hair is softer than the finest wool.

[The wild oxen of Louisiana, instead of hair, are covered with wool as fine as silk, and all curled. It is longer in winter than in summer, and is much used by the inhabitants. On their shoulders they have a pretty high bunch. Their horns are very fine, and are used by the hunters for carrying their powder. Between the horns, and toward the top of the head, there is a tuft of hair so thick that a pistol bullet, though discharged ever so near, cannot penetrate it. I tried the experiment myself. The flesh of these oxen is excellent, as well as that of the cow and calf; its flavour and juice are exquisite.—*Mem. sur la Louisiane.*]

We cannot hesitate in pronouncing these bisons of the New Continent to be the same species with those of the Old. They have preserved all the principal characters, as the bunch on the shoulders, the long hair under the muzzle and on the anterior parts of the body, and the short legs and tail: and upon comparing what has been said of them by Hernandez, Fernandez, and all the other travellers and historians of the New World, with what has been delivered concerning the European bison by ancient and modern naturalists, we shall be convinced that they are not animals of different species.

Thus the wild and domestic ox of Europe, Asia, Africa, and America, the bonasus, the aurochs, the bison, and the zebu, are animals of the same species, which, according to the differences of climate, of food, and of treatment, have undergone the various changes above described. The ox is not only the most useful animal, but most generally diffused; for it has been found every where except in South America. Its constitution is equally adapted to the ardours of the south, and the rigours of the north. It appears to be very ancient in all climates. It is domestic in civilized nations, and wild in desert countries or among unpolished people. From its own resources it supports itself in a state of nature, and never loses those qualities which render it serviceable to man. The young wild calves which are carried off from their mothers in India and Africa, soon become as gentle as those of the domestic race. This conformity in natural dispositions is a still farther proof of the identity of the species. Mildness of character in these animals indicates a physical flexibility in the form of their bodies; for in every species whose dispositions are gentle, and who have been subjected to a domestic state, there are more varieties than in those who, from an inflexibility of temper, have remained savage.

If it be asked whether the aurochs or the bison be the primitive race of oxen, a satisfactory answer may be obtained by drawing conclusions from the facts already related. The bunch of the bison, as formerly remarked, is an accidental character only, which is effaced by the commixture of the two races. The aurochs, or ox without a bunch, is therefore the most powerful and predominant race. Were it otherwise, the bunch, instead of disappearing, would extend, and subsist in all the individuals proceeding from a mixture of the two races. Besides, this bunch of the bison, like that of the camel, is not so much a production of nature as an effect of labour and a badge of slavery. In all ages, and in every country, the oxen have been obliged to carry burdens. Their backs, by constant and often excessive loads, have been deformed; and this deformity was afterwards transmitted by generation. There remained no oxen without this deformity except in those countries where they were not employed in carrying burdens. Throughout all Africa and the East the oxen are bunched; because at all periods they have carried loads on their shoulders. In Europe, where they are employed in the draught only, they have not undergone this deformed change, which is probably occasioned, in the first place, by the compression of the loads, and in the second, by a redundance of nourishment; for it disappears when the animal is meagre and ill fed. Domestic oxen with bunches might escape, or be abandoned in the woods, where their posterity would inherit the same deformity, which, instead of disappearing, would augment by the abundance of food peculiar to all uncultivated countries; so that this secondary race would spread over all the desert lands of the north and south, and pass, like the other animals which can support the rigours of cold, into the New Continent. The identity of the species of the bison and

aurochs is still farther confirmed from this circumstance, that the bisons of North America have so strong an odour of musk, that they have been called *musk oxen* by most travellers; and at the same time we learn, from the testimony of spectators, that the aurochs, or wild ox of Prussia and Livonia, has the same scent of musk.

[Fifteen leagues from the river Danoise is the river called *Sea-wolf*, both in the neighbourhood of Hudson's bay. In this country there is a species of ox called the *musk ox*, from his strong odour of musk, which in certain seasons renders his flesh uneatable. These animals have very fine wool, which is longer than that of the Barbary sheep. I had some of it sent me to France in the year 1708, of which I made stockings which were as fine as those of silk. These oxen, though smaller than ours, have larger and longer horns. Their roots join on the top of the head, and descend on the side of the eyes as low as the throat; then the tips mount up in the form of a crescent. I have seen two of them which weighed together sixty pounds. Their legs are so short that the wool always trails on the ground where they walk, which renders them so unshapely that it is difficult at a distance to know at which end the head is placed.—*Hist. de la Nouvelle France*, &c.]

Of all the names, therefore, prefixed to this article, which both by ancient and modern naturalists, are represented as so many distinct species, there remain only the buffalo and the ox. These two animals, though very similar, both domestic, often living under the same roof, and fed in the same pastures, though at liberty to intermix, and frequently stimulated to it by their keepers, have uniformly refused to unite. They neither copulate nor produce together. Their natures are more remote from each other than those of the ass and horse: they even seem to have a mutual antipathy; for we are assured that cows will not suckle young buffaloes, and that female buffaloes refuse to suckle calves. The disposition of the buffalo is more obstinate and untractable than that of the ox. He is less obedient, more violent, and subject to humours more frequent and more impetuous. All his habits are gross and brutal. Next to the hog he is the dirtiest of domestic animals; for nothing is more difficult than to dress and keep him clean. His figure is gross and forbidding. His aspect is wild and stupid. He stretches out his neck in an awkward ignoble manner, and carries his head so ungracefully, that it generally hangs down toward the ground. He bellows hideously, and with a strong and deeper tone than that of the bull. He has meagre limbs, a naked tail, a dark countenance, and a skin as black as his hair. He differs chiefly from the ox by this black colour of his skin: it appears under the hair, which is not close. His body is thicker and shorter than that of the ox, his legs longer, his head proportionally smaller, his horns less round, being black and compressed; and he has a tuft of curled hair on his front. His skin is also thicker and harder than that of the ox. His flesh is black and hard, and has not only a bad taste but a most disagreeable odour. [In travelling from Rome to Naples we are sometimes regaled with crows and buffaloes, and are happy to find them. The flesh of the buffalo is black, hard, and stinking, and none but poor people and the Jews of Rome are in the habit of eating it.—*Voyage de Misson.*]

The milk of the female buffalo is not so good as that of the cow; but she yields it in much greater quantity. In warm countries most cheeses are made of the buffalo's milk. The flesh of young buffaloes, though fed with milk, is not good.

[In entering Persia, by the way of Armenia, the first place worthy of notice is called the *Three Churches*, at the distance of three leagues from Erivan. In this country there are vast numbers of buffaloes, which serve the inhabitants for ploughing their lands. The females yield a great quantity of milk, of which butter and cheese are made. Some females give daily twenty-two pints of milk.—*Voyage de Tavernier.*

The female buffaloes go with young twelve months, and often give twenty-two pints of milk a-day, of which so great quantities of butter are made that in some of the villages on the Tigris we saw from twenty to twenty-five barks loaded with butter, to be sold along both sides of the Persic Gulf.—*Idem.*]

The skin is of more value than the rest of the animal, the tongue of which alone is good for eating. The skin is solid, pretty flexible, and almost impenetrable. As these animals are larger and stronger than oxen, they are employed with advantage in different kinds of labour. They are made to draw and not to carry burdens. They are directed and restrained by means of a ring passed through their nose. Two buffaloes yoked, or rather chained, to a chariot, draw as much as four strong horses. As they carry their neck and head low, the whole weight of their body is employed in drawing; and their mass much surpasses that of a labouring horse.

The height and thickness of the buffalo are sufficient indications that he originated from warm climates. The largest quadrupeds are produced in the Torrid Zone of the Old Continent; and the buffalo, in the order of magnitude, should be ranked next to the elephant, the rhinoceros, and the hippopotamus. The camelopard and the camel are taller, but thinner; and the whole are equally natives of the southern regions of Asia and Africa. Buffaloes, however, live and produce in Italy, in France, and in other temperate countries. Those kept in the royal menagerie have produced twice or thrice. The female brings forth but one at a birth, and goes with young about twelve months; which is a still farther proof of the difference of this species from that of the cow, whose time of gestation is only nine months.

It appears, likewise, that these animals are more gentle and less brutal in their native country; and that the warmer the country their disposition is the more docile. In Egypt they are more tractable than in Italy, and in India than in Egypt. The Italian buffaloes have also more hair than those of Egypt, and the Egyptian than those of India. Their fur is by no means close, because they belong to warm climates; and the large animals, in general, of these countries have little or no hair.

[In the kingdom of Aunan and Tonquin the buffaloes are very tall, and have high shoulders. They are also robust, and such excellent labourers, that one alone is sufficient to draw a plough, though the coulter enters very deep into the ground. Their flesh is not disagreeable; but that of the ox is better, and more commonly used.—*Hist. de Tonquin.*

At Malabar the buffalo is larger than the ox. He is shaped nearly in the same manner. His head is longer and flatter. His eyes are larger, and almost entirely white. His horns are flat, and often two feet long. His legs are thick and short. He is ugly, and almost without hair. He walks slowly, and carries heavy burdens. Like the cows they go in flocks; and their milk produces butter and cheese. Their flesh is good, though less delicate than that of the ox. They are excellent swimmers, and traverse the most rapid rivers. We have seen them tamed. But the wild buffaloes are extremely dangerous; for they tear men to pieces, or crush them with a single stroke of their heads. They are less to be feared in the woods than in any other situation; for their horns often entangle among the branches, which gives those time to fly who are pursued. The skin of these animals is used for a number of purposes; and even pitchers are made of it to keep water and other liquors. Those on the Malabar coast are almost all wild; and strangers are not prohibited from hunting and eating them.—*Voyage de Dellon.*]

In Africa and India there are vast quantities of wild buffaloes, which frequent the banks of rivers and extensive meadows. These wild buffaloes go in flocks, and make great havock in the cultivated fields. But they never attack men unless when they are wounded. They are then extremely dangerous; for they run straight upon the enemy, overturn him, and trample him under their feet. They are, however, afraid at the sight of fire, and they abhor a red colour. We are assured by Aldrovandus, and several other naturalists and travellers, that no person dare clothe himself in red in countries frequented by the buffalo. I know not whether this aversion to fire and a red colour be general among the buffaloes; for it is only some of our oxen which are enraged at the sight of red clothes.

[There are such numbers of wild buffaloes in the Philippine Isles, that a good hunter with a horse and a spear may kill thirty of them in a day. The Spaniards kill the buffalo for his skin, and the Indians for his flesh.—*Voyage de Gemelli Careri.*

We are told by the Negroes, that when they shoot at the buffaloes without wounding them mortally they dart with fury on the hunters, and trample them to death. The Negroes watch where the buffaloes assemble in the evening, climb a large tree, from which they fire upon them, and descend not till the animals are dead.—*Voyage de Bosman.*

At the Cape of Good Hope the buffaloes are larger than those of Europe. Instead of being black, like the latter, they are of a dark red colour. Upon the front there is a rude tuft of curled hair. Their whole body is well proportioned; and they advance their head very much forward. Their horns are very short, and hang down on the side of their neck; the tips bend inward, and nearly join. Their skin is so hard and firm that it is difficult to kill them without a good firelock. Their flesh is neither so fat nor so tender as that of ordinary oxen. The buffalo at the Cape turns furious at the sight of a red garment, or upon hearing a gun discharged over him. On these occasions he cries in a hideous manner, strikes with his feet, turns up the earth, and runs with fury against the man who has shot, or wears a red garment. Neither fire nor water can stop his course. Nothing but a high wall, or some similar obstacle, is capable of restraining him.—*Description de Bonne Esperance.*]

The buffalo, like all the large animals of warm climates, is fond of wallowing, and even of remaining in the water. He swims well, and boldly crosses the most rapid rivers. As his legs are longer than those of the ox, he runs more swiftly. The Negroes of Guinea, and the Indians of Malabar, where the buffaloes are very numerous, are fond of hunting them. They never attack these animals openly, but watch for them on the tops of trees, or lie hid in the thickets, through which the buffaloes cannot pass on account of their horns. These people esteem the flesh of the buffalo, and draw great profits from his skin and horns, which are harder and better than those of the ox.

The animal called *empacassa*, or *pacassa* at Congo, though very imperfectly described by travellers, appears to me to be the buffalo; and the animal mentioned under the name of *empabunga* or *impalunca*, in the same country, is perhaps the bubalus, whose history shall be given along with that of the gazelles or antilopes.

SUPPLEMENT.

The ox and bison are two distinct races of the same species. Though the bison uniformly differs from the ox by the bunch on his back, and the length of his hair,

he succeeds very well in the Isle of France: his flesh is much better than that of the European oxen; and after some generations his bunch vanishes entirely. His hair is smoother, his limbs are more slender, and his horns longer than those of the common ox. I saw, says M. de Querhoent, bisons brought from Madagascar which were of an astonishing size.

The bison, which we saw alive, was taken when young in the forests of the temperate parts of North America. It was brought to Holland, and purchased by a Swede, who transported it from town to town in a large cage, where it was firmly fixed by the head with four ropes. The enormous mane which surrounds its head is not hair, but a flowing wool divided into locks, like an old fleece. This wool is very fine, as well as that which covers the bunch and the anterior part of the body. The parts which appear naked are only so at a certain time of the year, which is rather in summer than in winter; for in the month of January all parts of the body were almost equally covered with a fine, close, frizzled wool, under which the skin was of a sooty colour; but on the bunch, and all the other parts which are covered with longer wool, the skin is tawny. This bunch, which consists entirely of flesh, varies according to the plight of the animal. To us he appeared to differ from the European by the bunch and the wool only. Though under much restraint he was not ferocious, but allowed his keepers to touch and caress him.

It would appear that there were formerly bisons in the north of Europe. Gessner even asserts, that in his time they existed in Scotland. Having enquired into this fact, I was informed, by letters both from Scotland and England, that no remembrance or vestige of them could be traced in that country. Mr. Bell, in his travels from Russia to China, mentions two species of oxen which he saw in the northern parts of Asia; one of which was the aurochs, or wild ox, and is the same race with our oxen; and the other, which we have denominated, after Gmelin, the *Tartarian*, or *grunting cow*, appeared to be the same species with the bison. After comparing this grunting cow with the bison I found an exact coincidence in all the characters, except the grunting instead of bellowing. But I apprehend that this grunting is not constant and general, but contingent and particular, similar to the deep interrupted voice of our bulls, which is never fully exhibited but in the season of love. Besides, I was informed, that the voice of the bison was never heard, and that, though considerably hurt, it did not complain, which induced his master to think that it was mute: and it is probable that its voice would be developed by grunting or interrupted sounds, when in full possession of freedom and in presence of a female, the animal's spirits were excited by love.

It is singular, that the bisons, or bunched oxen, whose race appears to be extended, in the Old Continent, from Madagascar and the point of Africa, and from the extremity of the East Indies as far Siberia, and that, in the New Continent, though they are found from the country of the Ilionois to Louisiana, and even Mexico, they should never have passed the isthmus of Panama; for there are no bisons in any part of South America, though the climate is perfectly agreeable to their nature, and the European oxen have multiplied there as well as in any other part of the globe.

At Madagascar the best kind of bulls and cows were brought thither from Africa, and have a bunch on their backs. The cows yield so little milk, that a single Dutch cow would give six times as much. In this island there are wild bisons which wander in the forests. The flesh of these bisons is not equal to that of our oxen. In the southern parts of Asia we likewise find wild oxen. The natives of Agra hunt these animals on the mountain of Nerwer, which is surrounded with wood. This mountain is situated on the road from Surat to Golconda. These wild cattle are generally beautiful, and sell very dear.

The zebu seems to be a miniature of the bison, whose race, as well as that of the ox, has undergone great variations, especially in size. The zebu, though an original native of very warm regions, is capable of existing and multiplying in temperate climates. 'I saw,' says Mr. Colinson, 'a great number of these animals in the 'Duke of Richmond's, and also in the Duke of Portland's 'parks, where they every year bring forth calves, which 'are extremely beautiful. The fathers and mothers were 'brought from the East Indies. The bunch on the 'shoulder is twice as large in the male as in the female, 'whose stature exceeds that of the male. The young 'zebu sucks its mother like other calves; but in our 'climate the milk of the mother soon dries up, and the 'suckling of the young is completed by the milk of 'another female. The Duke of Richmond ordered one 'of these animals to be slain; but its flesh was not so 'good as that of the ox.'

Among the oxen without bunches there are also small individuals, which, like the zebu, may constitute a particular race. Gemelli Careri, in his journey from Ispahan to Schiras, saw two small cows, which the bashaw of the province had sent to the king, and which exceeded not the size of calves. Though fed solely on straw they were very fat. In general, it appears, that the zebus, or small bisons, as well as our little oxen, are more fleshy and fatter than the bisons and oxen of the common size.

With regard to the buffaloes we have little to add. It shall only be remarked, that though they cannot use their horns they are made to fight lions and tigers in the Mogul's country. These animals are very numerous in all warm climates, especially in marshy countries, and in the neighbourhood of rivers. Water and a moist soil seem to be still more necessary to them than the warmth

of the climate. It is for this reason that none of them are found in Arabia, where almost the whole country is dry. The wild buffaloes are hunted, but with much caution; for they are exceedingly dangerous, and when wounded run against men with great fury. As to the domestic buffaloes, Niebuhr remarks, that in some places, as at Basra, it is the practice, when milking the female, to thrust the hand, as far as the elbow, into the vagina, because this operation makes her yield a greater quantity of milk. This fact appears not to be probable; but the female buffalo, like some of our cows, may forcibly retain her milk; and this gentle kind of titillation may relax the contraction of her teats.

At the Cape of Good Hope the body of the buffalo is of the same size with our ox; but he has shorter legs, and a larger head. He is a very formidable animal. He frequents the borders of the woods, and as his sight is not good he remains there with his head placed near the ground, in order the better to distinguish objects among the roots of the trees. When he perceives any disagreeable object near him he darts suddenly upon it, making at the same time a most hideous bellowing; and it is very difficult on these occasions to escape his fury. He is not so much to be dreaded in the open fields. His hair is red, and black in some places. They appear often in numerous flocks.

THE MOUFLON AND OTHER SHEEP.

THE Siberian goat has large horns bending back, close at their base, distant at their points, with circular rugæ. These animals vary in size and colour. The skin of the one the British museum did me the favour of accepting was covered with pale ferruginous hair, on the sides short, on the top of the neck longer, and a little erect. Along the lower side of the neck, and on the shoulders, the hair was fourteen inches long. Beneath the hair was a short wool. On the knees there was a bare spot, as if by kneeling to lie down. The tail was very short; and the horns were twenty-five inches long, eleven in girth in the thickest place, and one foot seven inches distant from point to point. The horns of the females are much less than those of the males.—*Pennant.*

The coat of the tragelaphus, says Belon, is similar to that of the he-goat; but he has no beard. His horns, which do not shed, resemble those of a she-goat; but they are sometimes twisted like those of a ram. He has the muzzle, front, and ears of a sheep; and his scrotum is likewise pendulous and large. His thighs under the tail are white, and the tail is black. Upon the breast and throat the hair is so long that he seems to have a beard. The hairs upon the shoulders and breast are long and black. He has two grey spots, one on each side of the flanks. His nostrils are black; and his muzzle, as well as the under part of his belly, are white. *Note*—This description of the tragelaphus by Belon agrees in every essential character with that we have given of the mouflon.

The weakest species of useful animals were first reduced to a domestic state. The sheep and goat were subjugated before the horse, the ox, or the camel. They were likewise more easily transported from one climate to another. From this source all the varieties among these species, as well as the difficulty of distinguishing the genuine stock of each, have proceeded. We formerly proved, that our domestic sheep in their present condition could not subsist without the support of man; from which it is apparent, that nature never produced them as they exist at present, but that they have degenerated under our care. We must therefore search among the wild animals for those which make the nearest approach to the sheep. We must compare them with the domestic sheep of foreign countries, examine the different causes which might introduce changes into the species, or make it degenerate, and endeavour, as in the case of the ox, to recall all these varieties, and all these pretended species, to one primitive race.

Our sheep in its present state exists no where but in Europe, and some of the temperate provinces of Asia. When transported into warm countries, as Guinea, it loses its wool, and is covered with hair: its fertility is diminished, and the taste of its flesh is altered. [The sheep are pretty numerous along the coast of Guinea, and yet they are very dear. They have the same figure with those of Europe, except that they are one half smaller, and instead of wool are covered with hair of an inch long. The flesh has not the smallest appearance of that of the European sheep, being extremely dry, &c.—*Voyage de Bosman.*] In very cold countries it cannot subsist. But in cold climates, and particularly in Iceland, we find a race of sheep with several horns, a short tail, and hard thick wool, under which, as in most northern animals, there is a layer of softer, finer, and more bushy wool. In warm countries, on the contrary, the sheep have generally short horns and a long tail, some of which are covered with wool, others with hair, and others with a mixture of wool and hair. The first of

these warm country sheep, which is commonly called the *Barbary sheep*, or the *Arabian sheep*, resembles the domestic kind in every respect except the tail, which is so loaded with fat that it is often more than a foot broad, and weighs above twenty pounds. Besides, there is nothing remarkable in this animal but its tail, which it carries as if a cushion were fixed to its thighs. Among this race of sheep there are some whose tails are so long and heavy, that they are obliged to be supported by a small wheel machine to enable the animals to walk. In the Levant this sheep is covered with very fine wool; but in warm countries, as Madagascar and the Indies, it is covered with hair. The redundance of fat, which in our sheep fixes about the kidneys, descends in these animals upon the vertebræ of the tail: the other parts of their bodies are less loaded with fat than our fed wedders. This variety should be attributed to the food, the climate, and the care of men; for those broad or long tailed sheep are domestic like ours, and even require more care and management. This race is much more diffused than that of the ordinary kind. It is common in Tartary, Persia, Syria, Egypt, Barbary, Æthiopia, Mosambique, Madagascar, and the Cape of Good Hope.

In the islands of the Archipelago, and particularly in Crete, there is a race of domestic sheep, of which Belon has given a figure and description under the name of *strepsicheros*. This sheep is of the same size with the common kind. Like the latter it is covered with wool, and differs from them only by having erect horns chamfered in the form of a screw.

In fine, we find in the warmer countries of Africa and India a race of large sheep with coarse hair, short horns, pendulous ears, with a kind of dewlap which hangs under the neck. This sheep is called by Leo Africanus and Marmol, *adimain;* and it is known to the naturalists under the name of the *Senegal sheep*, the *Guinea sheep*, the *sheep of Angola*, &c. It is domestic, like the other kind, and subject to the same varieties, which, though they differ in particular characters, have so many resemblances, that we must pronounce them to belong to the same race. Of all the domestic kinds this race appears to approach nearest to a state of nature. It is larger, stronger, nimbler, and consequently more capable of subsisting as a wild animal. But as it is only found in very warm climates, and cannot endure cold, and as even in its native climate it subsists not in a wild state, but is domestic, and requires the aid of man, it cannot be regarded as the primitive stock from which all other sheep have derived their origin.

[The wedders, or rather the rams of Senegal, for none of them are castrated, are a distinct and strongly marked species. They have nothing of the common kind but the head and tail. From the coarseness of their hair, they seem to be allied to the goat. It appears that wool would be incommodious to the sheep in very warm climates; and that nature has changed it into hair of a moderate length, and pretty thin.—*Voyage au Senegal.*

African sheep—It is meagre, very long legged, and tall, with short horns and pendant ears. It is covered with short hair instead of wool, and has wattles on its neck. Perhaps it is the *adimain* of Leo Africanus, which he says furnishes the Lybians with milk and cheese. It is of the size of an ass, and shaped like a ram.—*Pennant's Synopsis of Quadrupeds.*

The Guinea sheep differ from the European kind. They are generally longer legged, and have no wool, but short soft hair, like that of a dog. The rams have long manes, which sometimes hang down to the ground, and cover their necks from their shoulders to their ears, which are pendulous. Their horns are knobbed, pretty short, sharp, and bended forward. These animals are fat; their flesh is good and well flavoured, especially when they feed on the mountains or along the sea coasts; but it smells of tallow when they pasture on marshy grounds. The ewes are exceedingly prolific. They always bring forth two lambs at a time.—*Voyage de Desmarchais.*]

In considering domestic sheep, therefore, relative to the order of climate, we have, 1. The northern sheep with several horns, and whose wool is extremely coarse. The sheep of Iceland, Gothland, Muscovy, and other parts of the north of Europe, have all coarse hair, and seem to belong to the same race.

[Twenty Silesian shepherds arrived at Petersburg, and were afterwards sent to Cazan to shear the sheep, and to teach the Muscovites the mode of preparing wool. But this did not succeed; and the chief cause of its failure was said to be owing to the coarseness of the wool, the sheep and goats having always intermixed and produced together.—*Nouv. Mem. sur l'Etat de la Muscovie.*]

2. Our sheep, whose wool is very fine and beautiful in the mild climates of Spain and Persia, but which in very warm countries turns coarse. We have already remarked the conformity between the influence of the climates of Spain and of Chorazan, a province of Persia, upon the hair of goats, cats, and rabbits: it acts in the same manner upon the wool of sheep, which is very fine in Spain, and still finer in that part of Persia.

[At Meschet in the country of Corazan, on the frontiers of Persia, lamb skins formerly constituted a great article of commerce. The fleeces were of a beautiful silver gray colour, all curled, and finer than silk: those sheep which come from the mountains to the south of this city, and from the province of Kerman, afford the finest wool in Persia.—*Relation de la Grande Tartarie.*

The greatest part of this fine wool is furnished by the province of Kerman, which is the ancient Caramania; and the best kind comes from the mountains adjacent to the town, which has the same name with the pro-

vince. It is singular, that when the sheep of these places have eat the new herbage from January to May, the fleeces fall entirely off, and leave the animals as bare as scalded pigs; so that there is no occasion for shearing them, as in France. When the fleeces are collected they are beat or threshed; by which operation the coarser part separates, and leaves nothing but the fine. This wool is never dyed: it is naturally of a bright brown or a gray ash-colour, and very little of it is white.—*Voyage de Tavernier.*

The wedders of the Usbeck and Beschac Tartars have long grayish wool, curled at the ends into small white rings, which have the appearance of pearls. These fleeces are more esteemed than the flesh; because next to the sable they are the most valuable furs used in Persia. The animals are fed with great care, and generally in the shade. When obliged to be exposed to the open air, they are covered like our horses. The tail of these wedders is small, like that of the common kind.—*Voyage d'Olearius.*]

3. The large tailed sheep, whose wool is very fine in temperate countries, such as Persia, Syria, and Egypt; but in warmer climates it is converted into hair more or less coarse.

4. The strepsicheros or Cretan sheep. They resemble ours in every article but the horns, which are erect, and chamfered in a spiral form.

5. The *adimain*, or large sheep of Senegal and India, which are covered with hair more or less short and coarse, in proportion to the heat of the climate. All these sheep are only varieties of the same species, and would unquestionably produce with each other; since we know from experience that the he-goat, whose species is more remote, produces with our ewes. But though these five or six races of domestic sheep are all varieties of the same species, entirely produced by difference of climate, food, and management; yet none of them appear to be the primitive stock or source of all the rest. None of them are sufficiently strong or nimble to resist the carnivorous animals, or to escape from them by flight. All of them equally require care and protection. Hence the whole should be regarded as degenerate races, formed by the hand of man, and multiplied for his use. While he nourished, cultivated, and increased these domestic races, he would neglect, injure, and destroy the wild race, which, being strong and less tractable, would of course be more incommodious and less useful to him. The individuals of this race, therefore, would be small, and limited to such desert or thinly inhabited places as could afford them subsistence. Now in the mountains of Greece, in the islands of Cyprus, Sardinia, and Corsica, and in the deserts of Tartary, we find the animal called *mouflon*, which seems to be the primitive stock of all the different varieties of sheep. It lives in a state of nature, and subsists and multiplies without the aid of man. It resembles, more than any other wild animal, all the domestic kinds, and it is stronger, swifter, and more vivacious than any of them. It has the head, front, eyes, and face of the ram. It likewise resembles him in the figure of the horns, and in the whole habit of the body. In fine, it produces with the domestic sheep, which alone is sufficient to prove that it belongs to the same species, and is the primitive stock from which all the other varieties have originated. The only difference between the mouflon and our sheep is, that the former is covered with hair instead of wool. Now we have already seen, that in domestic sheep wool is not an essential character, but only a production of temperate climates; since in warm countries these same sheep lose their wool, and are covered with hair; and in very cold regions their wool is as coarse as hair. Hence it is by no means surprising that the primitive wild sheep, which must have been exposed to heat and cold, and must have multiplied without shelter in the woods and deserts, should not be covered with wool, which it would soon lose among the thickets, and its nature would be changed by the continual action of the air and temperance of the seasons. Besides, when the he-goat copulates with the domestic ewe, the produce is a kind of mouflon; for the lamb is covered with hair, and is not an unfertile mule, but a mongrel, which rises up toward the primitive species, and seems to indicate that the goat and our domestic sheep have something common in their origin; and as we know from experience that the he-goat easily produces with the ewe, but that the ram is incapable of impregnating the she-goat, it is evident, that among these animals, while in a domestic state, the goat is the predominant species. Thus our sheep is a species much more degenerated than that of the goat; and it is extremely probable that if the she-goat were served with a mouflon, instead of a domestic ram, she would produce kids which would approach to the species of the goat, as the lambs produced by the he-goat and ewe rise toward the original species of the ram.

I am aware of objections to this doctrine from those systematic naturalists who found all their knowledge of natural history upon some particular characters; and therefore shall endeavour to prevent them. The first character, they will say, of the ram is to carry wool, and the first character of the goat is to be covered with hair. The second character of the ram is to have horns bended in a circular form, and turned backward, and that of the he-goat is to have them straight and erect. These, they will affirm, are the essential and infallible marks by which sheep and goats will always be distinguished; for they must acknowledge that every other article is common to both. None of them have cutting teeth in the upper jaw; but each of them has eight in the under jaw. In both the canine teeth are wanting; their hoofs

are equally divided, and their horns are simple and permanent. Both have their paps situated in the region of the belly; and both feed upon herbage. Their internal structure is still more similar; for it appears to be the very same. The number and form of their stomachs, the structure and disposition of their intestines, the substance of the flesh, the qualities of the fat and seminal liquor, the times of gestation and growth, and the duration of their lives, are exactly the same. There remain, therefore, only the wool and the horns by which these two species can be distinguished. But it has already been shown, from facts, that wool is not so much a natural substance as a production of climate, aided by the care of man. The sheep of warm and of cold countries, and wild sheep, have no wool. Besides, in very mild climates the goats may be said to have wool instead of hair; for that of the Angora goat is finer than the wool of our wedders. This character, therefore, is not essential, but purely accidental, and even equivocal; for it may equally belong to these two species, or be wanting altogether, according to the difference of the climates. That of the horns appears to be still less certain; for they vary in number, size, figure, and direction. In our domestic sheep the rams have generally horns, and the ewes have none. I have seen sheep not only with two, but with four horns. Those of the north and of Iceland have sometimes eight. In warm countries the rams have only two short horns, and often want them, like the ewes. In some the horns are smooth and round; in others they are flat and chamfered. The points, instead of being bended backward, are sometimes turned outward, forward, &c. This character therefore is not more constant than the former; and consequently it is not sufficient to constitute different species. Neither can the thickness or length of the tail answer this purpose; since it may be considered as an artificial member, which by great care and abundance of good nourishment may be enlarged at pleasure. Besides, among our domestic races, as in certain British sheep, there are some which have tails longer than the common kind. Our modern naturalists, however, trusting solely to the differences in the horns, the wool, and the largeness of the tail, have made seven or eight distinct species out of the sheep kind. The whole of these we have reduced to one. And this reduction seems to be so well founded, that there is little prospect of its being overturned by future observations.

[Linnæus with great propriety, instead of six species, has made six varieties only of domestic sheep. All these sheep are only varieties, to which this author should have added the *adimain* or Guinea sheep and the *strepsicheros* of Crete, instead of making them two different species. In the same manner, if he had seen the mouflon, and had known that it produced with the sheep, or had only consulted the passage of Pliny concerning the mouflon, he would never have ranked it with the goat, but with the sheep. Brisson has not only placed the mouflon and strepsicheros, which he calls *hircus laniger*, among the goats, but he has made four distinct species of domestic sheep covered with wool, beside the domestic sheep of warm countries covered with hair, and the broad and long tailed sheep. All these seven we have reduced to a single species.]

In composing the history of wild animals we found it convenient to examine them one by one, without any regard to genus, but in the domestic animals, on the contrary, it was necessary not only to adopt but to increase the number of genera; because in nature there exist only individuals, and successions of individuals, that is, species. Men have had no influence on independent animals; but they have greatly altered and modified the domestic kinds. We have therefore established physical and real genera, very different from those metaphysical and arbitrary ones, which have no existence but in idea. These physical genera are in reality composed of all the species, which, by our management, have been greatly variegated and changed; and as all those species, so differently modified by the hand of man, have but one common origin in nature, the whole genus ought to constitute but a single species. In writing, for example, the history of tigers, we have admitted as many species as are really found in different parts of the earth; because we are certain that man has never introduced any changes among these untractable and ferocious animals, who subsist at present in the same manner as they were originally produced by nature. The same remark applies to all free and independent animals. But in composing the history of oxen and sheep, we have reduced all the varieties of the oxen to one ox, and all the varieties of the sheep to one sheep; because it is equally certain that man, and not nature, has produced the different kinds which we have enumerated. Every thing concurs in supporting this idea, which, though clear in itself, may not perhaps be sufficiently understood. That all the oxen produce together we are assured by the experiments of M. de la Nux, Mentzelius, and Kalm: that all the sheep produce with one another, with the mouflon, and even with the goat, I know from my own experience. All the varieties of oxen therefore form but one species; and all the sheep, however numerous their varieties, constitute only another species.

I am obliged, by the importance of the subject, to repeat, that nature is not to be judged of by particular minute characters, and that by these the differences of species are not to be determined; that methodical distributions, instead of throwing light on the history of animals, render it still more obscure, by a fruitless multiplication of denominations and of species; by forming arbitrary genera which nature never knew; by

confounding real beings with creatures of imagination; by giving false ideas of the essential characteristics of species; and by mixing or separating them in an arbitrary manner, without skill, and often without having examined or even seen the individuals. It is for this reason that our nomenclators perpetually deceive themselves, and publish nearly as many errors as lines. Of this we have already given so many examples, that nothing but the blindest and most obstinate prejudice can possibly resist the evidence they afford. On this subject M. Gmelin talks very sensibly, when treating of the animal under consideration.

['The *argali*, or *stepnie-barani*, which occupy,' says he, 'the southern mountains of Siberia, from the river Irtis, as far as Kamstchatka, are extremely vivacious animals; and this vivacity seems to exclude them from the class of sheep, and to rank them with that of the stags. I shall here give a short description of them, from which it will appear that neither sprightliness nor inactivity, neither the wool nor hair with which an animal is covered, neither crooked nor straight horns, neither permanent horns, nor those which fall off annually, are marks sufficiently characteristic to distinguish classes. Nature loves variety; and I am persuaded that if we knew better how to manage our senses, they would often lead us to more essential characters, with regard to the differences of animals, than we generally derive from reason, which seldom apprehends those marks but in a superficial manner. In this animal the external form of the head, neck, and tail, corresponds with that of the stag. His vivacity also, as formerly remarked, is so great, that he seems to be still more wild than the stag. The individual I saw, though reputed to be only three years old, ten men durst not attack. The largest of this species are about the size of a fallow deer. The one I examined measured, from the ground to the top of the head, a Russian ell and a half in height. His length, from the root of the horns, was an ell and three quarters. The horns rise above and very near the eyes, and just before the ears. They first bend backward and then forward in a circular form. The tips turn upward and outward. The horns, from the root to the middle, are furrowed, but afterward become somewhat smoother. It is probably from the figure of the horns that the Russians have called this animal the *wild sheep*. If we can trust the natives of these provinces his whole strength lies in his horns. They say that the rams of this species fight by striking each other with their horns; and when any of them are knocked off the aperture of the base is so large that the young foxes frequently take shelter in the cavity. It is not difficult to estimate the force necessary to break off one of these horns, since they, as long as the animal lives, continue to augment both in thickness and in length; and the part of the head also from which they spring becomes always harder. It is said, that a well grown horn, comprehending the curvatures, measures two ells in length; that it weighs between thirty and forty Russian pounds; and that at the base it is seven or eight inches in diameter. The horns of the one I saw were of a whitish yellow colour; but they turn browner and blacker as the animal advances in years. He carries his ears, which are pointed and tolerably large, very erect. The hoofs are divided, and the fore legs are three quarters of an ell long, and the hind legs still longer. When the animal stands erect on a plain, his fore legs are always fully extended and straight, and those behind are crooked; and this curvature seems to diminish in proportion to the inequality of the ground over which he passes. On the neck there are some pendulous folds. The colour of the body is grayish, mixed with brown. Along the back there is a yellowish or rather reddish line; and the same colour appears behind, on the inside of the legs, and on the belly, where it is a little paler. This colour continues from the beginning of August to the spring, at the approach of which these animals cast their hair, and become every where more red. They cast their hair a second time about the end of July. This description applies to the males. The females are always smaller; and though they have similar horns, they are smaller and thinner, and even acquire not thickness with age. The horns are nearly straight, have no furrows, and much resemble those of our castrated he-goats.

In their internal parts they resemble other ruminating animals. The stomach is composed of four different cavities, and the gall-bladder is considerably large. Their flesh is good, and has nearly the same taste with that of the roebuck. The fat is delicious, according to the testimony of the Kamtschatkan nations. They feed upon herbage. They couple in autumn, and bring forth one or two lambs in the spring.

By the hair, the taste of the flesh, the figure and vivacity of this animal, it belongs to the class of the stag. By the permanent horns it is excluded from this class. The circular horns give it some resemblance to the sheep. It is distinguished from that animal by its vivacity and want of wool. Its hair, its abode upon high rocks, and its frequent combats, make it approach to the goats. But the crooked horns, and the want of a beard, exclude it from this class. Should we not rather regard this animal as constituting a particular class, and recognise it as the *musimon* of the ancients? In a word, it has a strong resemblance to Pliny's description of the musimon, and still more to that given by the learned Gessner.'—*Relation d'un Voyage par terre a Kamtschatka, par Gmelin.*]

We are convinced, as M. Gmelin remarks, that we can never acquire a knowledge of nature but by a judicious use of our senses, by seeing, examining, comparing, and at the same time by denying ourselves the

liberty of fabricating methodical distributions, contemptible systems, in which animals are classed which the authors never saw, and knew nothing more of them than their names, which are often ambiguous, obscure, and misapplied. The false employment of these names confounds ideas in a farrago of words, and drowns truth in a torrent of error. We are likewise convinced, after examining the mouflon alive, and comparing him with Gmelin's description, that the argali is the same animal. We formerly remarked, that this animal was found in Europe, and in pretty warm countries, such as Greece, the island of Cyprus, Sardinia, and Corsica. But it is still more numerous in the southern mountains of Siberia, under a climate rather cold than temperate, where it even appears to be larger, stronger, and more vigorous. Hence it might equally supply the north and the south; its offspring might be rendered domestic. After suffering long the hardships of this state it would degenerate; and according to the differences of climate and treatment would assume relative characters and new habits of body, which, being afterward transmitted by generation, gave rise to our domestic sheep and all the other races formerly enumerated.

[The tragelaphus of Belon is unquestionably our mouflon; and we perceive, from his remarks, that he saw, described, and drew a figure of this animal in Greece, and that it is found in the mountains between Macedonia and Servia.

In the island of Cyprus there are rams denominated by the ancient Greeks, according to Strabo, *musmones*, and called by the present Italians *mufione*. Instead of wool they are covered with hair, like that of goats; or rather their skin and hair differ little from those of the stag. Their horns resemble those of rams; but they are bent backward. They are as tall and as large as a middle sized stag. They run with great swiftness; but they never quit the highest and most rugged mountains. Their flesh is good and savoury. The skins of these animals are dressed, and sent to Italy, where they go by the name of *cordoani* or *corduani*.—*Descript. des Isles de l'Archipel. par Dapper.*]

THE AXIS.

DEER with slender trifurcated horns; the first branch near the base, and the second near the top, each pointing upwards. It is of the size of the fallow deer, of a light grey colour, and the body is beautifully marked with white spots. Along the lower part of the sides next the belly is a line of white. The tail, which is as long as that of a fallow deer, is red above and white beneath.

This animal being known only under the vague names of *Sardinian hind* and *stag of the Ganges*, we have preserved the appellation given to it by Belon, which he borrowed from Pliny, both because the characters correspond with Pliny's axis, and the name has never been applied to any other quadruped; and therefore we are in no danger of falling into error or confusion; for a generic denomination, accompanied with an epithet derived from the climate, is not a name, but a phrase by which an animal may be confounded with others of its own genus, as the present animal with the stag, though perhaps it is different both in species and in climate.

[In the court of this castle there were a male and a female of a kind of *stag* or *fallow deer*, which we should never have recognised if we had not suspected that it was the *axis* mentioned by Pliny. Both of them wanted horns, and like the fallow deer had long tails that hang as low as the hocks, by which we knew that they were not stags; and in fact, at first sight, we thought they were fallow deer. But upon a closer examination we rejected this opinion. The female is smaller than the male; and their skin was variegated with round white spots. The ground colour of the body was yellowish, and white on the belly. In this article they differ from the camelopard; for the ground colour of the camelopard is white, and the spots are reddish. Their voice is clearer than that of the stag; for having heard them bray we were certain that they could neither be fallow deer nor stags, and therefore believed them to be the *axis* of the ancients.—*Belon's Observ.*]

The axis is one of the small number of ruminating animals which carry horns like those of the stag. He has the stature and swiftness of the fallow-deer. But what distinguishes him from both he has the horns of the stag, and the figure of the fallow-deer; his whole body is marked with white spots, elegantly disposed, and separate from each other; and, lastly, he is a native of warm climates. But the hair of the stag and fallow deer is generally of a uniform colour, and they are very numerous in cold and temperate regions as well as in warm climates.

[This animal was in the royal menagerie under the name of the *Ganges stag*. From this denomination, as well as from the passages of Pliny and Belon, it appears

that he is a native of warm countries. The testimonies of travellers, which we are about to quote, confirm this fact, and at the same time prove, that the common species of the stag is not much diffused beyond the temperate climates. 'I never saw,' says le Maire, 'stags at Senegal with horns like those of France.'—*Voyage de le Maire.*

'In the peninsula of India, on this side the Ganges, there are stags whose bodies are all interspersed with white spots.'—*Voy. de la Comp. des Indes d'Hollande.*

'At Bengal we find stags which are spotted like tigers.'—*Voyage de Luillier.*]

The gentlemen of the Academy of Sciences have given a figure and description of the internal parts of this animal; but they have said little concerning its external form, and nothing relative to its history. They have simply called it the *Sardinian hind*, probably because it was brought to the royal menagerie under that name. But we have no evidence of this animal's being a native of Sardinia. It is mentioned by no author as existing wild in this island; on the contrary, we see, from the passages already quoted, that it is found in the warmest countries of Asia. Hence the denomination of *Sardinian hind* has been falsely applied: that of *Ganges stag* would have been more proper, if it had belonged to the stag species, because that part of India through which the Ganges runs appears to be its native country. It seems however to be likewise found in Barbary, and it is probable that the spotted fallow deer of the Cape of Good Hope is the same animal.

[The height of these hinds, from the top of the back to the tail, was two feet eight inches. The neck was a foot long, and the hind legs three feet. Their hair was of four colours, namely, yellow, white, black, and gray. It was white on the belly and on the inside of the thighs and legs. The back was a yellowish brown, and the flanks were of a dun yellow, or isabella colour. These ground colours were variegated with white spots, of different figures. Along the back were two rows of spots in a straight line; the other spots were scattered without any order. On each side of the flanks there was a white line. The neck and head were gray; the tail was all white below, black above, and the hair of it was six inches long.—*Mem. pour servir a l'Hist. des Animaux.*

The Arabs call a species of fallow deer *bekker-el-wash*, which has the horns of a stag, but is not so large. Those which I saw had been taken in the mountains near Sgigata, and appeared to be of a mild and tractable disposition. The female had no horns, &c.—*Shaw's Travels.*

We saw, at the Cape of Good Hope, a kind of spotted fallow deer, which were somewhat smaller than those of Europe. Their spots were white and yellow. They always go in flocks.—*Kolbe's Descript.*]

We formerly remarked, that no species made so near an approach to another as the fallow deer to the stag. The axis however seems to form an intermediate shade between the two. It resembles the fallow deer in the size of the body, the length of the tail, and in a kind of livery which it perpetually wears: there is no essential difference but in the horns, which want brow antlers, and resemble those of the stag. The axis therefore may be a variety only, and not a different species from that of the fallow deer; for though it is a native of the warmest countries of Asia it easily subsists and multiplies in Europe. There are flocks of them in the menagerie of Paris. They produce among themselves with equal facility as the fallow deer. They have never been observed however to intermix with the fallow deer nor with the stags, which has led us to presume that they are not a variety either of the one or of the other, but a distinct intermediate species. But as no decisive experiments have been made on this subject, as no necessary means have been used to oblige these animals to join, we do not assert positively that they belong to different species.

We have already seen, under the articles *stag* and *fallow deer*, how liable these animals are to varieties, especially in the colour of their hair. The species of the fallow deer and stag, without being numerous in individuals, are very much diffused. Both are found in either continent, and both are subject to a great number of varieties, which seem to form permanent races. The white stags, whose race is very ancient, since they are mentioned by the Greeks and Romans, and the small brown stags, which we have called *Corsican stags*, are not the only varieties of this species. In Germany there is another race, known in that country under the name of *brandhirtz*, and by our hunters under that of the *stag of Ardennes*. This stag is larger than the common kind, and differs from the others not only by its deep and almost black colour, but by long hair between the shoulders and on the throat. This kind of mane and beard give him some relation, the first to the horse, and the second to the he-goat. The ancients bestowed on this stag the compound names of *hippelaphus* and *tragelaphus*. As these denominations have occasioned many critical discussions, in which the most learned naturalists by no means agree; and as Gessner, Caius, and others, tell us that the *hippelaphus* was the rein deer, we thought it proper here to give the reasons which induce us to think differently, and lead us to believe, that the hippelaphus of Aristotle is the same animal with the tragelaphus of Pliny, and that both these names equally denote the stag of Ardennes.

Aristotle gives to his hippelaphus a kind of mane upon the neck and top of the shoulders, a beard under the throat, horns to the male similar to those of the roebuck, and no horns to the female. He says, that the

hippelaphus is as large as the stag, and is produced among the Arachotas, a people of India, where there are also wild oxen, whose bodies are very robust, their skin black, their muzzle elevated, and their horns bended more backward than those of the domestic ox. It must be acknowledged, that Aristotle's characters of the hippelaphus will apply almost equally well to the rein deer and to the stag of Ardennes. They have both long hair upon the neck and shoulders, and likewise on the throat, which forms a kind of beard upon the gullet, and not on the chin. But the hippelaphus, which is of the size of the stag only, differs in this particular from the rein deer, which is much larger; but what appears to decide this question, the rein deer, being an animal peculiar to cold countries, never existed among the Arachotas. This country of the Arachotas is one of the provinces which Alexander over-ran in his expedition into India. It is situated beyond Mount Caucasus, between Persia and India. This warm country never produced rein deer; for they cannot subsist in temperate countries, and are found only in the northern regions of both continents. The stags, on the contrary, have no particular attachment to the north; for they are very numerous both in temperate and warm climates. Hence the hippelaphus of Aristotle, which is found among the Arachotas, and in the same countries with the buffalo, is unquestionably the stag of Ardennes, and not the rein deer.

Now if we compare what Pliny has said of the tragelaphus with what Aristotle has advanced concerning the hippelaphus, and both with nature, we will perceive that the tragelaphus is the same animal with the hippelaphus, and consequently the same with our stag of Ardennes. Pliny remarks, that the tragelaphus belongs to the species of stag, and differs from him only by the beard and the hair on its shoulders. These characters are positive, and can apply only to the stag of Ardennes; for Pliny, in another place, mentions the rein deer under the name of *alca*. He adds, that the tragelaphus is found in the neighbourhood of Phasis, which still farther agrees with the stag, and not with the rein deer. We may therefore safely pronounce, that the tragelaphus of Pliny and the hippelaphus of Aristotle both denote the animal which we call the *stag of Ardennes;* and that the axis of Pliny is the animal commonly denominated the *Ganges stag*. Though names have no influence upon nature, the explication of them is of great use to those who study her productions.

SUPPLEMENT.

In the year 1765 the Duke of Richmond had in his parks a number of that species of the fallow deer, commonly known by the name of *Ganges stags*, and which I have called *axis*. Mr. Colinson assures me, that they propagated with the ordinary kind of fallow deer.

'They live spontaneously,' he remarks, 'with the 'fallow deer, and form not separate flocks. It is more 'than sixty years since this species existed in England, 'where they had been transported before the white and 'and black fallow deer, and even before the stag, which 'last, I suppose, was brought from France; because 'previous to that period there were in England only the 'common fallow deer and the Scottish roebuck. But 'beside this first species, we have now the axis, the 'black, the yellow, and the white fallow deer. The 'mixture of all these colours has produced most beau-'tiful varieties.'

In the year 1764 we had a male and female Chinese fallow deer at the menagerie of Versailles. In height they exceeded not two feet four inches. The body and tail were of a dark brown colour, and the belly and limbs of a bright yellow. The legs were short, the horns large and garnished with antlers. This species, though smaller than the common fallow deer, and even than the axis, is perhaps a variety only of the latter, though it has no white spots; but instead of these white spots it had in some places large yellow hairs, which had a considerable effect upon the brown colour of the body. In fine, the colour of the female was the same as that of the male; and it is probable, that the race might not only be perpetuated in France, but that it might even intermix with the axis, especially as both these animals are natives of the eastern regions of Africa.

THE ZEBU OR DWARF OX.

THE zebu from which the following description was taken was not larger than a calf of five weeks old. We knew it however to be an adult, and at least seven or eight years of age by inspection of its teeth. It arrived at the menagerie of Versailles in the month of August, 1761, and its horns were then as large as they are now in the year 1763. They are five inches three lines long, and four inches three lines in circumference at the base. They are black at the points, and in every other respect resemble those of the common ox. It has a bunch on

the withers four inches and a half high, and its circumference at the base is sixteen inches. In other articles it differs not in figure from our ox except that its legs and feet are proportionally smaller and its ears longer.

The tuft of hair above the coronet is black. The legs and upper part of the tail are yellowish. The under part, and the long hairs at the point of the tail, are white, and a foot in length. The rest of the body is variegated with black and brown spots, of different dimensions, and slightly tinged with a reddish colour.

[Dwarf ox, with horns almost close at their base, broad and flat at the beginning, receding in the middle, and standing erect. It is larger than a roebuck, less than a stag, and compact and well made in all its limbs. Its hair is shining, and of a tawny colour. Its legs are short, neck thick, and shoulders a little elevated. The tail is terminated with long hairs, twice as coarse as those of a horse. It is only a variety of the Indian ox.—*Pennant.*]

This small ox was mentioned above under the article buffalo. But as since this article was printed, a zebu has been brought to the royal menagerie, we are now in a condition to speak of it with more certainty, and to give a figure of it drawn from the life, with a more perfect description than the former one. I have also learned, from fresh enquiries that the zebu is probably the same animal which is called the *lant* or *dant* in Numidia, and several other northern provinces of Africa, where it is very common; and that the name *dant*, which solely pertains to the animal under consideration, has been transported from Africa to America, and given to an animal which has no resemblance to the former but in the size of its body, and belongs to a very different species. This American dant is the tapir or the mapouri; and to prevent the African dant, which is our zebu, from being confounded with the tapir, we shall give the history of the latter in the subsequent article.

[The dant, which the Africans call *lampt*, is of the figure of a small ox, but its legs are short. It has black horns, which bend round, and are smooth. Its hair is whitish, and its hoofs are black and cloven. It is so swift that no animal unless the Barbary horse can overtake it. These animals are said to be more easily taken in summer, because, by the force of running, their hoofs are worn among the burning sands, and the pain occasioned by this circumstance makes them stop short, like the stags and fallow deer of these deserts. There are numbers of these dants in the deserts of Numidia and Lybia, and particularly in the country of the Morabitains. Of their skins the natives make excellent shields, the best of which are proof against arrows.]

THE TAPIR.

THE tapir has the fore hoofs divided into four, and the hind hoofs into three parts. The nose extends far beyond the under jaw, is slender, and forms a sort of proboscis; it is capable of being contracted or extended at pleasure, and its sides are sulcated. The extremities of both jaws end in a point, and there are ten cutting teeth in each. Between them and the grinders there is a vacant space, and there are ten grinders in each jaw. The ears are erect, the eyes small, and the body shaped like a hog. The back is arched, the legs short, and the hoofs small, black, and hollow. The tail is very small. The animal grows to the size of a heifer of half a year old. The hair is short; when young it is spotted with white, when old it is of a dusky colour.

This is the largest animal of the New World, where, as formerly remarked, animated nature seems to be contracted, or rather not to have had time sufficient to acquire her full dimensions. Instead of the huge masses produced by the ancient lands of Asia, instead of the elephant, rhinoceros, the hippopotamus, camelopard, and camel, all the creatures of these new lands are modelled upon a small scale. The tapirs, the lamas, the pacos, and the cabiais, are twenty times smaller than the animals of the Old World to which they should respectively be compared. Here matter is not only used with a niggardly hand, but even forms are imperfect, and seem to have failed, or been neglected. Almost the whole animals of South America, which alone can be regarded as peculiar to the New World, have neither tusks, horns, nor tails. Their figure is awkward; their bodies and members are ill-proportioned; and some of them, as the ant-eaters, the sloth, &c. are so miserably formed, that they have hardly the powers of moving or of eating their food. With much difficulty they drag out a painful and languishing life in the solitudes of the desert, and cannot subsist in inhabited regions, where man and the stronger animals would soon destroy them.

The tapir is of the size of a small cow or zebu; but has neither horns nor tail. His legs are short and his body arched. When young he is spotted like the stag; and afterwards his hair becomes of a uniform deep brown

colour. His head is large, and terminates, like that of the rhinoceros, in a long trunk. He has ten cutting teeth and an equal number of grinders in each jaw, a character which separates him entirely from the ox kind, and from all other ruminating animals. As we have only some skins of this animal, and a drawing sent us by M. Condamine, we cannot do better than transcribe the descriptions of him made from the life by Marcgrave and Barrere, subjoining at the same time what has been said concerning him by travellers and historians. The tapir seems to be a gloomy melancholy animal. He comes abroad in the night only, and delights in the water, where he dwells oftener than on the land. He lives in the marshes, and never wanders to any great distance from the margins of rivers and lakes. When alarmed, pursued, or wounded, he plunges into the water, remains long under it, and passes over a considerable space before he makes his appearance. These habits, which he possesses in common with the hippopotamus, have induced some naturalists to suppose that he belongs to the same species. But these animals are as remote from each other in their natures as the countries they inhabit. To be ascertained of this fact we have only to compare the above descriptions with that we have given of the hippopotamus. Though both inhabit the water the tapir does not feed upon fishes; and though his mouth is armed with twenty sharp cutting teeth, he is not carnivorous. He lives upon plants and roots, and never uses his weapons against other animals. His dispositions are so mild and timid that he declines all hostilities, and flies from every danger. Though his legs are short, and his body heavy, he runs very swiftly, and swims still better than he runs. The texture of his skin is so close and firm that it often resists a musket ball. His flesh is coarse and insipid; but it is eaten by the Indians. He is found in Brasil, in Paraguay, in Guiana, in the country of the Amazons, and throughout all South America, from the extremity of Chili to New Spain.

[The *tapir* or *maypouri* is an amphibious animal, being oftener in the water than on the land, to which he resorts from time to time in order to browse the more tender herbage. His hair is very short, and interspersed with black and white bands, which extend from the head to the tail. He makes a kind of hissing or whistling noise; and seems to partake a little both of the mule and the hog. We find *manipouris*, as they are called by some people, in the river Ouyapok. His flesh is coarse and ill tasted.—*Barrere.*

During the day the anta browses herbage, and in the night he eats a kind of clay found in the marshes, to which he retires when the sun sets. The antas are hunted during the night, and it is not a difficult business. These animals are hunted in their retreats, where they assemble spontaneously in flocks; and as soon as they approach, the hunters run up to them with burning torches, with which they are so dazzled and confounded that they overturn one another.—*Charlevoix.*]

OF NATURE.

FIRST VIEW.

NATURE is that system of laws established by the Creator for regulating the existence of bodies and the succession of beings. Nature is not a body; for this body would comprehend every thing. Neither is it a being: for this being would necessarily be God. But Nature may be considered as an immense living power which animates the universe, and which, in subordination to the first and supreme Being, began to act by his command, and its action is still continued by his concurrence or consent. This power is that portion of the divine power which manifests itself to men. It is at once the cause and the effect, the mode and the substance, the design and the execution. Very different from human art, whose productions are only dead works, Nature is herself a work perpetually alive, an active and never ceasing operator, who knows how to employ every material, and though always labouring on the same invariable plan, her power, instead of being lessened, is perfectly inexhaustible. Time, space, and matter, are her means; the universe her object; motion and life her end.

The phænomena of the universe are the effects of this power. The springs she employs are active forces, which time and space can only measure and limit, but never destroy; forces which balance, mix, and oppose, without being able to annihilate each other. Some penetrate and transport bodies, others heat and animate them. Attraction and impulsion are the two principal instruments by which this power acts upon brute matter. Heat and organic particles are the active principles she employs in the formation and expansion of organized beings.

With such instruments what can limit the operations of Nature? To render her omnipotent she wants only the power of creating and annihilating. But these two extremes of power the Almighty has reserved to himself alone. To create and to annihilate are his peculiar attributes. To change, to destroy, to unfold, to renew, to produce, are the only privileges he has conferred on another agent. Nature, the minister of his irrevocable commands, the depositary of his immutable decrees, never deviates from the laws he has prescribed to her. She alters no part of his original plan; and in all her operations she exhibits the zeal of the eternal Lord of the universe. This divine impression, this unalterable prototype of all existence, is the model upon which she operates; a model, all the features of which are expressed in characters so strongly marked that nothing can possibly efface; a model which the number of copies or impressions, though infinite, instead of impairing, only renews.

Every thing therefore has been created, and nothing is annihilated. Nature vibrates between these two extremes, without ever reaching either the one or the other. Let us endeavour to lay hold of her in some points of this vast space which she has filled and pervaded from the beginning of ages.

What an infinity of objects! an immense mass of matter, which would have been created in vain, if it had not been divided into portions, separated from each other by spaces a thousand times more immense. Thousands of luminous globes, placed at inconceivable distances, are the bases which support the fabric of the universe; and millions of opaque globes, which circulate round the former, constitute the moving order of its architecture. These great masses are revolved, and carried through space, by two primitive forces, each of which acts continually; and their combined efforts produce the zones of the celestial spheres, and establish in the midst of vacuity fixed stations and determined routes or orbits. It is motion that gives rise to the equilibrium of worlds and the repose of the universe.

The first of these forces is equally divided; the second is distributed in unequal proportions. Every atom of matter has the same quantity of attractive force; and a different quantity of impulsive force is assigned to each individual globe. Some stars are fixed, and others wandering. Some globes seem to be destined for attracting, and others for impelling or being impelled. There are spheres which have received a common impulsion in the same direction, and others a particular impulsion. Some stars are solitary, and others accompanied with satellites: some are luminous, and others opaque masses. There are planets, the different parts of which successively enjoy a borrowed light, and comets, which lose themselves in the profundity of space, and return after many ages to receive the influence of solar heat. Some suns appear and disappear, and seem to be alternately kindled and extinguished; others exhibit themselves for once, and then vanish for ever. Heaven is a country of great events; but the human eye is hardly able to perceive them. A sun which perishes and destroys a world, or a system of worlds, has no other effect on our eyes than an ignis fatuus, which gives a transitory blaze and appears no more. Man, limited to the terrestrial atom on which he vegetates, views this atom as a world, and sees worlds only as atoms.

The earth which man inhabits, hardly perceptible among the other globes, and totally invisible to the distant spheres, is a million of times smaller the sun by which it is illuminated, and a thousand times smaller than some of the planets, which are also subjected to the power of the sun, and obliged to circulate around him. Saturn, Jupiter, Mars, the Earth, Venus, Mercury, and the Sun, occupy the small part of the heavens which we call *our Universe*. All these planets with their satellites, moving with rapidity in the same direction, and nearly in the same plane, compose a wheel of an immense diameter, whose axis supports the whole weight, and which, by the celerity of its own rotation, must inflame and diffuse heat and light to every part of the circumference. As long as these movements continue, (and they will be eternal, unless the hand of the prime Mover interpose, and exert as much force to destroy as was necessary to create them,) the sun will burn, and fill all the spheres of this universe with his splendour: and as in a system where all bodies attract each other nothing can be lost, or remove without returning, the quantity of matter remaining always the same, this fertile source of light and life can never be dried up or exhausted; for the other suns, which likewise dart forth their fires continually, restore to our sun as much light as they receive from him.

The comets, which are much more numerous than the planets, and like the latter depend on the power of the sun, press also on this focus, and by augmenting the weight, increase the inflammation. They constitute a part of our universe; for, like the planets, they are subject to the attraction of the sun. But in their projectile or impelled motions they have nothing in common, either among themselves or with the planets. Each circulates in a different plane; and they describe orbits in very different periods of time; for some perform their revolutions in a few years, and others require several centuries. The sun, revolving round his own centre, remains in other respects, perfectly at rest in the midst of the whole, and serves at the same time as a torch, a focus, and an axis to all the parts of this vast machine.

It is by his magnitude alone that the sun remains immoveable, and regulates the motions of the other globes. As the force of attraction is proportioned to the mass of matter, as the sun is incomparably larger than

any of the comets, and contains a thousand times more matter than the largest planet, they can neither derange him nor diminish his influence, which, by extending to immense distances, restrains the whole, and at fixed periods recalls those which have stretched farthest into the regions of space. Some of them, when they return, make so near an approach to the sun, that, after cooling for ages, they undergo an inconceivable degree of heat. They are subjected to strange vicissitudes from these alternate extremes of heat and cold, as well as from the inequalities of their motions, which are sometimes prodigiously accelerated, and at other times almost infinitely retarded. When compared with the planets, the comets may be considered as worlds in disorder; for the orbits of the planets are more regular, and their movements more equal; their temperature is always the same; they seem to be places of repose, where, every thing being permanent, Nature is enabled to establish a uniform plan of operation, and to mature successively all her various productions. Among the planets that which we inhabit seems to enjoy peculiar privileges. Less cold and less distant than Saturn, Jupiter, and Mars, it is also not so much scorched as Venus and Mercury, which appear to be too near the body of the sun. Besides, with what magnificence does Nature shine upon the earth! A pure light, which gradually stretches from east to west, alternately gilds both hemispheres of this globe. It is surrounded with a light and transparent element. A mild and fertile heat animates and unfolds all the germs of existence; and they are nourished and supported by wholesome waters. Various eminences, distributed over the surface of the land, stop and collect the moist vapours which float in the air, and give rise to perpetual fountains. Immense cavities, destined for the reception of these waters, separate islands and continents. The extent of the sea is as great as that of the land. This is not a cold and barren element. It is a new empire equally rich, and equally peopled with the former. The limits of the waters are marked out by the finger of God. If the sea encroaches on the western shores it deserts those of the east. This vast mass of waters, though naturally inactive, is agitated by the influence of the celestial bodies, which produces the regular motions of the flux and reflux. It rises and falls with the course of the moon, and when the action of the sun and moon concurs, it rises still higher. Both these causes uniting during the time of the equinoxes, is the reason why the tides are then highest. This is the strongest mark of our connection with the heavens. These constant and general movements give rise to variable and particular motions; to transportations of earth, which, falling to the bottom in the form of sediment, produce mountains similar to those on the surface of the land; to currents, which, following the direction of those chains of mountains, bestow on them a figure whose angles correspond, and running in the midst of the waves, as waters run on the land, are really sea rivers.

The air, still lighter and more fluid than water, is likewise subject to a number of powers. Continual agitations are produced in it by the distant influence of the sun and moon, by the immediate action of the sea, and by the rarefaction and condensation of heat and cold. The winds are its currents. They push and collect the clouds. They produce meteors, and transport to the arid surface of islands and continents the moist vapours of the ocean. They give rise to storms, and diffuse and distribute the fertile dew and rains. They disturb the movements of the sea, agitate the waters, stop or precipitate the currents, elevate the waves, and raise tremendous tempests: the troubled ocean rises toward the heavens, and rolls on with noise and violence against those immoveable barriers which with all its efforts it can neither destroy nor surmount.

The earth, elevated above the level of the ocean, is defended against its irruptions. Its surface, enamelled with flowers, adorned with a verdure which is always renewing, and peopled with numberless species of animals, is a place of perfect repose, a delightful habitation, where man, destined to aid the intentions of Nature, presides over every other being. He alone is capable of knowledge, and dignified with the faculty of admiration: God therefore has made him the spectator of the universe, and the witness of his perpetual miracles. The ray of divinity with which he is animated makes him participate the mysteries of the Deity. It is by this light that he thinks and reflects, that he perceives and understands the wonderful operations of his Creator.

Nature is the external throne of the divine magnificence. Man, who contemplates her, rises gradually to the internal throne of the Almighty. Formed to adore his Creator he has dominion over every creature. The vassal of heaven, the lord of the earth, he peoples, ennobles, and enriches this lower world. Among living beings he establishes order, subordination, and harmony. To Nature herself he even gives embellishment, cultivation, extension, and polish. He cuts down the thistle and the bramble, and he multiplies the vine and the rose. View those melancholy deserts where man has never resided. Over-run with briars, thorns, and trees which are deformed, broken, corrupted, the seeds that ought to renew and embellish the scene are choaked and buried in the midst of rubbish and sterility. Nature, who in other situations assumes the splendour of youth, has here the appearance of old age and decrepitude. The earth, surcharged with the spoils of its productions, instead of a beautiful verdure, presents nothing but a disordered mass of gross herbage, and of trees loaded with parasitical plants, as lichens, agarics, and other impure fruits of corruption: all the low grounds are occupied with putrid and stagnating waters; the miry

lands, which are neither solid nor fluid, are impassable, and remain equally useless to the inhabitants of the earth and of the waters; and the marshes, which are covered with stinking aquatic plants, serve only to nourish venomous insects, and to harbour impure animals. Between those putrid marshes which occupy the low grounds, and the decayed forests which cover the elevated parts of the country, there is a species of lands or savannas, that have no resemblance to our meadows. There noxious herbs rise and choak the useful kinds. Instead of that fine enamelled turf which appears to be the down of the earth, we see nothing but rude vegetables, hard prickly plants, so interlaced together that they seem to have less hold of the earth than of each other, and which, by successively drying and shooting, form a coarse mat of several feet in thickness. There is no road, no communication, no vestige of intelligence, in these savage and desolate regions. Man, reduced to the necessity of following the track of wild beasts, when he wants to kill them, obliged to watch perpetually lest he should fall a victim to their rage, terrified by their occasional roarings, and even struck with the awful silence of those profound solitudes, he shrinks back, and says: 'Uncultivated Nature is hideous and languishing. It is 'I alone who can render her agreeable and vivacious. 'Let us drain these marshes; let us animate these 'waters by converting them into brooks and canals; let 'us employ this active and devouring element, whose 'nature was formerly concealed from us; let us set fire 'to this cumbersome load of vegetables, and to those 'superannuated forests which are already half consumed; 'let us finish the work by destroying with iron what 'could not be dissipated by fire. Instead of rushes and 'water-lilies, from which the toad is said to extract his 'poison, we shall soon see the ranunculus, the truffle, 'and other mild and salutary herbs; flocks of sprightly 'cattle will browse upon this land which was formerly 'impassable; here they will find abundance of food, a 'never failing pasture, and they will continue to multiply, and to reward us for our labours, and the protection we have afforded them. To complete the work, 'let the ox be subjected to the yoke; let his strength 'and the weight of his body be employed in ploughing 'the ground, which acquires fresh vigour by culture. 'Thus will Nature acquire redoubled strength and 'splendour from the skill and industry of man!'

How beautiful is cultivated Nature! How pompous and brilliant when decorated by the hand of man! He himself is her chief ornament, her noblest production. By multiplying his own species he increases the most precious of her works. She even seems to multiply in the same proportion with him; for by his art he brings to light every thing which she concealed in her bosom. What a source of unknown treasures! Flowers, fruits, and grains matured to perfection, and multiplied to infinity; the useful species of animals transported, propagated, and increased without number; the noxious kinds diminished, and banished from the abodes of men; gold, and iron, a more useful metal, extracted from the bowels of the earth; torrents restrained, and rivers directed and confined within their banks; even the ocean itself subdued, investigated, and traversed from the one hemisphere to the other; the earth every where accessible, and rendered active and fertile; the valleys and plains converted into smiling meadows, rich pastures, and cultivated fields; the hills loaded with vines and fruits, and their summits crowned with useful trees; the deserts turned into populous cities, whose inhabitants spread from its centre to its utmost extremities; open and frequented roads and communications every where established as so many evidences of the union and strength of society. A thousand other monuments of power and of glory sufficiently demonstrate that man is the lord of the earth; that he has entirely changed and renewed its surface; and that, from the remotest periods of time he alone has divided the empire of the world between him and Nature.

He reigns, however, by the right of conquest only. He enjoys rather than possesses; and preserves his privileges by perpetual vigilance and activity. If these are interrupted, every thing languishes, alters, and returns to the absolute dominion of Nature. She resumes her rights, effaces the operations of man, covers with moss and dust his most pompous monuments, which in the progress of time she totally destroys, and leaves him only the regret of having lost by his own fault what his ancestors had acquired by their industry. Those periods when man loses his empire, those barbarous ages in which every thing of value perishes, commence with war, and are completed by famine and depopulation. Man, whose strength consists solely in the union of numbers, and whose happiness is derived from peace, is yet mad enough to take up arms, and to fight, which are never failing sources of misery and ruin. Incited by insatiable avarice, and by blind ambition, which is still more insatiable, he renounces the feelings of humanity, turns all his strength against himself, and his whole desires centre in the destruction of his own species, which he soon accomplishes. After these days of blood and carnage, when the intoxicating fumes of glory are dispelled, he surveys, with a melancholy eye, the earth desolated, the arts buried, nations dispersed, an enfeebled people, the ruin of his own happiness, and the annihilation of his real power.

Omnipotent God! whose presence supports Nature, and maintains harmony among the laws of the universe; who, from thy immoveable throne in the Empirean, seest all the celestial spheres rolling under thy feet, without deviation or disorder; who, from the bosom of

repose, renewest at every instant their vast movements, and who alone governest, in profound peace, an infinite number of heavens and of earths! restore, restore tranquillity to a troubled world! Let the earth be silent! Let the presumptuous tumults of war and discord be dispelled by the sound of thy voice! Merciful God! Author of all beings, thy paternal regards embrace every created object: but man is thy chief favourite. Thou hast illuminated his mind with a ray of thy immortal light; penetrate also his heart with a shaft of thy love: this divine sentiment, when universally diffused, will unite the most hostile spirits; man will no longer dread the aspect of man, and his hand will cease to be armed with murdering steel; the devouring flames of war will no more dry up the sources of generations; the human species, now weakened, mutilated, and prematurely mowed down, will germinate afresh, and multiply without number: Nature, groaning under the pressure of calamity, sterile, and abandoned, will soon resume, with accumulated vigour, her former fecundity; and we, beneficent God, we shall aid, cultivate, and incessantly contemplate her operations, that we may be enabled to offer thee every moment a fresh tribute of gratitude and admiration.

THE ZEBRA.

THE zebra has a short erect mane; the tail is furnished with long hairs at the end; and the whole body is beautifully striped, from the back to the belly, with lines of brown, on a very pale buff ground. It is the most elegant of all quadrupeds.

Whether we consider symmetry of shape, or beauty of colours, the zebra is perhaps the most elegant of all quadrupeds. In this animal the figure and gracefulness of the horse are united with the nimbleness of the stag. His robe is adorned with black and white belts or ribands, alternately disposed, with such regularity and exact proportion, that Nature seems here to have employed the rule and the compass. These alternate bands of black and white are the more singular, because they are straight, parallel, and as nicely separated as those of a striped stuff. Besides, they extend not only over the body, but the head, thighs, legs, and even the ears and tail; so that at a distance the whole body of the animal has the appearance of being artificially adorned in the most elegant manner with ribands. In the female these bands are alternately black and white, and black and yellow in the male. The shades are always lively and brilliant: and the hair is short, close, and fine, the lustre of which augments the beauty of the colours. The zebra in general is smaller than the horse, and larger than the ass. Though he has often been compared to these two animals under the names of the *wild horse*, and *striped ass*, he is not a copy of either, but should rather be regarded as their model, if in Nature every species were not equally original, and had not an equal right to creation.

The zebra therefore is neither a horse nor an ass; for though it has often been attempted, we never learned that they intermixed and produced together. She-asses in season were presented to the zebra which was in the menagerie of Versailles in the year 1761. He disdained them, or rather discovered no emotion. He however sported with them, and even mounted them, but without discovering any desire or external sign. This coldness could be attributed to no other cause than an unsuitableness in the natures of the two animals; for the zebra was four years of age, and in every other exercise was sprightly and vigorous.

The zebra is not the animal mentioned by the ancients under the name of *onager*. In the Levant, in the eastern parts of Asia, and in the north of Africa, there is a fine race of asses, which, like the most beautiful horses, originated in Arabia. This race differs from the common kind by the largeness of their body, the nimbleness of their limbs, and the lustre of their hair. They are of one uniform colour, which is a beautiful mouse gray, with a black cross on the back and shoulders. Sometimes their colour is a brighter gray with a whitish cross. These African and Asiatic asses, though more beautiful than those of Europe, proceed equally from the *onagri* or *wild asses*, which are still numerous in South and East Tartary, in Persia, Syria, the islands of the Archipelago, and in Mauritania. The onagers differ from the domestic asses by those qualities only which result from freedom and independence: they are stronger and more nimble, and they have more courage and vivacity. The figure of their bodies is the same, though their hair is longer. This difference depends likewise on their condition; for our asses would have hair equally long, if they were not shorn at the age of four or five months. The hair of a colt is at first nearly as long as that of a young bear. The skin of the wild ass is equally hard as that of the domestic kind, and we are assured that it is full of small tubercles. The chagrin brought from the Levant, which we employ for various purposes, is said to be made of the wild ass's skin.

[In Persia there are two kinds of asses; those belonging to the country, which, like ours, are slow and stupid, and used for carrrying burdens only; and the Arabian asses, which are extremely handsome, and the most excellent of the species. They have smooth hair, a high head, and nimble limbs. They are used solely for riding. Like horses, they are trained to amble; and their motion is extremely soft, and so fleet, that it requires a gallop to keep up with them.—*Tavernier.*

At Bassora I saw a wild ass. Its figure differed not from that of the domestic kind; but its colour was brighter, and from the head to the tail there was a band of whitish hair. In running, and in every other motion, it seemed to be much more nimble than the common kind.—*Pietra della Valle.*

The Moors, who come to Cape Verd to traffick, carry their baggage and wares upon asses. These animals were so beautiful and so smooth skinned, that it was with difficulty I could recognise them to be asses. Those of Europe, I imagine, would be in the same condition, if their labour, and the manner in which they are loaded, did not greatly disfigure them. Their hair was of a beautiful, shining, mouse gray colour, upon which the black band along the back, and across the shoulders, had a fine effect. These asses are a little larger than ours. Their head however is easily distinguishable from that of the horse, especially the Barbary horse, which is a native of this country, and of a still higher stature.—*M. Adanson.*

There are great numbers of wild asses in the deserts of Numidia and Lybia, and the adjacent country. They are so fleet that the Barbary horses alone are able to overtake them in the course. As soon as they see a man, they stop, fling up their heels, and cry; and when he is near, they run off. They are taken by various kinds of snares. They go in troops to pasture and to drink. Their flesh is very good; but it must be allowed to cool two days after being roasted on account of its strong smell. We have seen a number of these animals in Sardinia; but they were smaller.—*Marmol.*]

But neither the onager, nor the fine asses of Arabia, can be regarded as the origin of the zebra species, though they resemble it in figure and swiftness. None of them exhibit that regular variety of colours by which the zebra is so eminently distinguished. This beautiful species is singular, and very remote from all other kinds. It likewise belongs to a different climate from that of the onager, being only found in the eastern and southern regions of Africa, from Æthiopia to the Cape of Good Hope, and from thence as far as Congo. He exists not in Europe, Asia, America, nor in any of the northern parts of Africa. Those mentioned by some voyagers to have been found in Brasil had been transported thither from Africa. Others, which have been seen in Persia, and in Turkey, had been brought to these countries from Æthiopia. In fine, almost all those we have seen in Europe came from the Cape of Good Hope. This point of Africa is their native climate, where they are very numerous, and where the Dutch have exerted every effort to tame and render them domestic; but they have not hitherto been able fully to accomplish this purpose. The zebra, which was the subject of our description, was extremely wild when he arrived at the royal menagerie, and is not yet entirely tamed. They have however brought him the length of being mounted; but it requires great precaution. Two men hold the bridle, while a third sits on the animal's back. His mouth is extremely hard; his ears are so sensible, that he flings whenever they are touched; and, like a vicious horse, he is restless, and as stubborn as a mule. But the wild horse and the onager are perhaps equally untractable; and it is extremely probable, that if the zebra were early accustomed to obedience, and to a domestic state, he would become equally gentle with the ass and horse, and might supply the place of both.

[At the Cape of Good Hope there are numbers of wild asses, which are the most beautiful in the world. They are finely striped with black and white bands, and are very difficult to tame.—*Chaumont.*

The wild ass of the Cape is one of the most beautiful animals I have ever seen. He is of the size of an ordinary saddle horse. His limbs are slender, and well proportioned, and his hair is soft and close. From the mane to the tail a black band runs along the back, from which numbers of other bands of *different colours* proceed, and form circles by meeting under the belly. Some of these circles are white, others yellow, and others chesnut; and their various shades run into each other in such a manner as charms the eye of the spectator. His head and ears are also adorned with small bands of the same colours. Those on the mane and tail are mostly white, chesnut, or brown, and few of them yellow. He is so fleet that no horse in the world can be compared to him. Hence it is extremely difficult to catch him, and when caught he sells very dear. I have often seen large troops of these animals. Father Tellez, Thevenot, and other authors, assert, that they have seen them tamed; but I never heard of their being tamed at the Cape. Several Europeans have ineffectually exerted all their skill and industry to accomplish this end.—*Kolbe's Descript.*

When I arrived in Brasil I saw two very rare animals, which were of the figure and size of a small mule; yet they are not mules; for they are fertile. The skin is extremely beautiful, very smooth, short, and shining like velvet. The hair is disposed into fine white and black bands, which run in the most exact proportion over the whole body, ears, tail, and other extremities.

Moreover, these animals are very fierce, and never can be fully tamed. They are called in the country from which they are brought *esvres*. They are natives of Angola in Africa, from whence they were transported to Brasil, in order to be afterwards presented to the king of Spain. Though they had been taken when very young, and were a little tamed, nobody durst approach them except their keeper. Some time before I arrived one of them had broke loose, and killed a groom. Though tied up very close, the keeper showed m eseveral bites he had received from them. The skin of the animal is extremely beautiful.—*Pyrard.*]

SUPPLEMENT.

The ass, either in a domestic or wild state, is found in almost every warm and temperate climate of the Old Continent, and existed not in the New when it was first discovered. But the species, after being transported thither from Europe, has now subsisted and multiplied greatly in America, during more than two centuries; so that at present it is almost equally diffused over the four quarters of the globe. The zebra, on the contrary, which was brought to us from the Cape of Good Hope, seems to be a species limited to the southern regions of Africa; though Lopez asserts, that the zebras are more frequent in Barbary than in Congo, and though Dapper relates that troops of them are found in the forests of Angola.

This beautiful animal, which, both from the variety of its colours and the elegance of its figure, is so superior to the ass, seems notwithstanding to be nearly of the same species; since most travellers give it the name of the *striped ass*, because at first sight they are struck with its superior resemblance, both in size and figure, to the ass than to the horse; for it was not with the small common asses that they compared the zebra, but with the largest and most beautiful of the species. I am still inclined to think, however, that the zebra approaches nearer to the horse than the ass; for his figure is so elegant, that though in general he is smaller than the horse, the similarities between them in other respects are very apparent. To confirm this opinion, it has been remarked, with some degree of surprise, that in the neighbourhood of the Cape of Good Hope, which appears to be the native country of the zebra, there are horses spotted on the back and belly with yellow, black, red, and azure. This particular argument is supported by the general fact, that in all climates the colour of the horse varies more than that of the ass. We pretend not to decide this question; but we hope it will soon be determined. As the Dutch have lately transported great numbers of these elegant animals, and have even yoked them in the stadtholder's chariot, it is probable, that in a short time we shall receive information of every thing relating to their nature. That industrious nation cannot fail to make these animals unite among themselves, and perhaps with horses and asses, in order to produce direct or bastard races. In Holland there are several expert naturalists who will perhaps succeed better than we did in the multiplication of the zebra, upon which only a single experiment was made at the royal menagerie in the year 1761. The male, which was four years of age, disdained the she-asses, though in season, and no more were presented to him. Perhaps he was also too young. Besides, he was not rendered familiar with the females, a necessary preliminary for succeeding in the union of different species, which Nature seems to require even in the intercourse of individuals of the same species.

The fertile mule of Tartary, called *czigithai*, may perhaps be an animal of the same species with the zebra; for there seems to be no difference between them but in colour. Now it is well known that the differences in the colour of the hair or feathers are extremely slight, and depend on the influence of the climate. The czigithai is found in the southern parts of Siberia, in Thibet, in Dauria, and in Tartary. Gerbillon remarks, that these animals are common in the country of the Mongoux and Kakas; that they differ from domestic mules; and that they cannot be trained to bear burdens. Muller and Gmelin assure us that they are numerous in the country of the Tongusians, where they are hunted like other game; that in Siberia, toward Borsja, they are very plenty in dry years; and he adds, that they resemble, in figure, size, and colour, a bright bay horse, except that they have very long ears, and a tail like that of a cow. If the travellers who examined the czigithai had at the same time compared it with the zebra, they would perhaps have discovered a greater number of relations than we are apt to imagine. In the Petersburgh cabinet there are stuffed skins both of the zebra and czigithai. Though these skins differ in colour, they may belong to the same, or a very neighbouring species. Time alone can remove or confirm these conjectures. But as all the other animals of Africa are likewise found in Asia, if the zebra and czigithai are not of the same species, the zebra alone would be an exception to this general rule.

Besides, if the czigithai is not the same with the zebra, it may be the Asiatic animal called *onager* or *wild ass*. The onager should not be confounded with the zebra; but I am uncertain whether the same remark is applicable to the onager and czigithai; for from comparing the relations of travellers, it appears, that there are different kinds of wild asses, of which the onager is the most remarkable. Perhaps the horse, the ass, the onager, and the czigithai, constitute four distinct species: and on the supposition that they are only three, it is still uncertain whether the czigithai be an onager or a zebra. The swiftness of the onager is mentioned by

travellers, who remark, that he runs with such rapidity as to escape the hunters, though mounted on horses; and they say the same thing of the czigithai. However this matter stands, the horse, the ass, the zebra, and the czigithai, belong to the same genus, and constitute three or four branches of the same family; the two first of which have long been reduced to a domestic state. We may therefore hope that the two last may likewise be tamed, and prove a useful acquisition to mankind.

THE HIPPOPOTAMUS.

THE hippopotamus has four cutting teeth in each jaw. Those in the middle are straight and pointed forward, the two middlemost the largest. It has four tusks, those in the upper jaw are short, and the lower very long, and truncated obliquely. The head is of an enormous size, and the mouth is vastly wide. The ears are small and pointed, and lined within very thickly with short fine hairs. The eyes and nostrils are small in proportion to the bulk of the animal. On the lips there are some strong hairs scattered in patches here and there. The hair on the body is very thin, of a whitish colour, and scarce discernible at first sight. There is no mane on the neck, as some writers feign, only the hairs on that part are rather thicker. The skin is very thick and strong, and of a dusky colour. The tail is about a foot long, taper, compressed, and naked. The hoofs are divided into four parts; but notwithstanding it is an amphibious animal, they are not connected by membranes. The legs are short and thick. In bulk it is second only to the elephant. The length of a male has been found to be seventeen feet, the circumference of the body fifteen, the height near seven, the legs near three, the head above three and a half, and the girth near nine feet.

Though the hippopotamus has been celebrated from the remotest antiquity; though the sacred writings mention him under the name of *behemoth;* and though his figure is engraved on the Egyptian obelisks, and on the Roman medals, yet he was very imperfectly known to the ancients. Aristotle speaks of this animal in the most superficial manner; and in the little he says there are more errors than truth. Pliny copies Aristotle, and instead of correcting adds to the number of his blunders. It was not till about the middle of the sixteenth century that any precise information was obtained concerning this animal. Belon, being then at Constantinople, saw a living hippopotamus, of which, however, he gives but an imperfect representation; for the two figures which he has added to his description were not drawn from the animal he saw, but were copied from the reverse of Adrian's medal, and from the Egyptian colossus at Rome. Hence the æra of any exact knowledge concerning this animal must be brought forward to the year 1603, when Frederico Zerenghi, a surgeon of Narni in Italy, printed at Naples the history of two hippopotami which he had taken alive in a great ditch dug on purpose in the neighbourhood of the Nile near Damietta. This little book was written in Italian; and though it be the only thing original we have upon this subject, it seems to have been totally neglected both by contemporary and succeeding naturalists. The description it contains of the hippopotamus is at the same time so good, and appears so worthy of credit, that I shall here give an extract and translation of it.

'With a view,' says Zerenghi, 'of obtaining an hippopotamus, I stationed men upon the Nile, who, having seen two of these animals go out of the river, made a large ditch in the way through which they passed, and covered it with thin planks, earth, and herbage. In the evening, when returning, to the river, they both fell into the ditch. I was immediately informed of the event, and hastened to the place along with my janissary. We killed both the animals by pouring three shot into each of their heads from a large arquebuse. They almost instantly expired, uttering a cry that had more resemblance to the bellowing of a buffalo than to the neighing of a horse. This exploit was perfomed on the 20th day of July, 1600. The following day they were drawn out of the ditch, and carefully skinned. The one was a male, and the other a female. I caused their skins to be salted, and stuffed with the leaves of the sugar cane, in order to transport them to Cairo, where they were salted a second time with more attention and convenience. Each skin required four hundred pounds of salt. On my return from Egypt, in 1601, I brought these skins to Venice, and from thence to Rome. I showed them to several intelligent physicians. Dr. Jerome Aquapendente, and the celebrated Aldrovandus, were the only persons who recognised them to be the spoils of the hippopotamus; and as Aldrovandus's work was then printing, I allowed him to draw a figure from the skin of the female, which he inserted in his book.

'The skin of the hippopotamus is very thick, and

'very hard; it is even impenetrable, unless after being 'long steeped in water. The mouth is not, as the an- 'cients alledge, of a middle size, but enormously large. 'Neither are his feet divided into two toes but into four. 'His size is not that of an ass; for he is much larger 'than the largest horse or buffalo. His tail resembles 'not that of a hog, but rather that of the tortoise, only 'it is incomparably larger. His muzzle is not turned 'up, but resembles that of the buffalo, and is much 'larger. He has no mane, but only a few short scat- 'tered hairs. He neighs not like a horse; but his voice 'is a medium between the bellowing of a buffalo and 'the neighing of a horse. He has no tusks which pro- 'trude out of the mouth; for when the mouth is shut, 'the teeth, though extremely large, are all concealed 'within the lips. The inhabitants of this part of Egypt 'call him *foras l'bar*, which signifies the *sea-horse*. Be- 'lon's description is very erroneous: he gives to this 'animal the teeth of the horse, which would lead us to 'think, contrary to his own assertions, that he had 'never seen it; for the teeth of the hippopotamus are 'very large and very singular. To remove every uncer- 'tainty,' continues Zerenghi, 'I here give the figure of 'the hippopotamus with all the dimensions and propor- 'tions of the body and members, drawn exactly accord- 'ing to nature.

'The length of this hippopotamus, from the extre- 'mity of the upper lip to the origin of the tail, is nearly 'eleven feet two inches. [This and the following mea- sures are all Paris feet and inches.]

'The circumference of the body is about ten feet.

'The height, from the sole of the foot to the top of 'the back, is four feet five inches.

'The circumference of the legs, near the shoulders, is 'two feet nine inches, and when taken lower, one foot 'nine inches and a half.

'The height of the legs, from the sole of the foot to 'the breast, is one foot ten inches and a half.

'The length of the feet, from the extremity of the 'nails, is about four inches and a half.' *Note*—I have here taken a mean between Zerenghi's two measures for the length of the feet.

'The nails, or divisions of the hoof, are as long as 'they are broad, being two inches and two lines.

'Each toe has a nail, and each foot four toes. The 'skin on the back is near an inch, and that on the belly 'about seven lines thick.

'The skin when dried is so hard that a musket ball 'cannot pierce it. The country people make large 'shields of it, and likewise use it for thongs or whips. 'On the surface of the skin there are a few scattered 'whitish hairs, which are not perceptible at first sight. 'On the neck the hairs are longer, and all of them 'placed one by one, at greater or smaller distances from 'each other. But on the lips they form a kind of whis- 'kers; for in several places ten or twelve of them issue 'from the same point. These hairs are of the same 'colour as the others, only they are harder, thicker, and 'somewhat longer, though none of them exceed half an 'inch in length.

'The length of the tail is eleven inches four lines: 'its circumference at the origin is a little more than a 'foot, and at the extremity two inches ten lines.

'The tail is not round; but from the middle to the 'point it is flattened, like that of an eel. Upon the tail 'and the thighs there are some round scales, of a whitish 'colour, and as large as lentils. These small scales like- 'wise appear on the breast, the neck, and some parts of 'the head.

'From the extremity of the lips to the beginning of 'the neck, the head is four feet four inches.

'The circumference of the head is about five feet 'eight inches.

'The ears are two inches nine lines long, two inches 'three lines broad, a little pointed, and garnished in the 'inside with fine, short, thick hairs, of the same colour 'as the others.

'The eyes, from one corner to the other, are two 'inches three lines; and the eye-lids are distant from 'each other one inch one line.

'The nostrils are two inches four lines long, and one 'inch three lines broad.

'The mouth opens to the width of one foot five 'inches four lines. It is of a square form, and furnished 'with forty-four teeth of different figures. All these 'teeth are so hard that they strike fire with steel. It is 'chiefly the enamel of the canine teeth which possesses 'this degree of hardness, the internal substance of the 'whole being softer. When the hippopotamus keeps 'his mouth shut, no teeth appear without, but are all 'covered with the lips, which are extremely large.

[In three heads of the hippopotamus, preserved in the royal cabinet, there are only thirty-six teeth. As these heads are smaller than that described by Zerenghi, it may be presumed that, in young hippopotami, all the grinders are not developed, and that adults have eight more.]

'With regard to the figure of the hippopotamus, it ap- 'pears to be a medium between those of the buffalo and 'hog, because it participates of both, except the cutting 'teeth, which have no resemblance to those of either of 'these animals. The grinding teeth have some similarity 'to those of the buffalo or horse, though they are much 'longer. The colour of the body is dusky and blackish. 'We are assured that the hippopotamus produces but 'one at a time; that he lives upon fishes, crocodiles, 'and even cadaverous flesh. He eats, however, rice, 'grain, &c. though if we consider the structure of his 'teeth, it would appear that nature had not destined 'him for pasture, but for devouring other animals.'

Zerenghi finishes his description by informing us, that all these measures had been taken from the female subject, and that the male perfectly resembled her, except that in all his dimensions he was one third larger. It were to be wished that the figure given by Zerenghi had been equally good as his description: this animal, however, was not drawn from the life, but from the skin of the female. It likewise appears, that Fabius Columna took his figure from the same skin, which was preserved in salt. But Columna's description is not equal to that of Zerenghi; and he even merits reproach for mentioning only the name, and not the work of this author, though it was published three years before his own. For example, Columna remarks, that in his time (1603) Frederico Zerenghi brought from Egypt to Italy an entire hippopotamus, preserved in salt, though Zerenghi himself expressly tells us, that he brought only the skin. Columna makes the body of his hippopotamus thirteen feet long, and fourteen feet in circumference, and the legs three feet and a half in length; while by the measures of Zerenghi the body was only eleven feet two inches long, its circumference ten feet, the legs one foot ten inches and a half, &c. We can have no dependence therefore on Columna's description; neither can he be excused by supposing that his description was taken from another subject; for it is evident, from his own words, that he described the smallest of Zerenghi's two hippopotami, since he acknowledged, that some months afterward Zerenghi exhibited a second hippopotamus, which was much larger than the first. I have insisted upon this point, because nobody has done justice to Zerenghi, though he merits the highest eulogiums. On the contrary, all naturalists, for these hundred and sixty years, have ascribed to Fabius Columna what was due to Zerenghi alone; and instead of inquiring after the work of the latter, they have contented themselves with copying and praising that of Columna, though with regard to this article he is neither original, exact, nor even honest.

[Perhaps the foot used by Columna was shorter than the Paris foot. But this circumstance will not justify him; for the body of his hippopotamus being thirteen feet long, its circumference ought to have been only eleven feet seven or eight inches, and not fourteen feet. The other proportions are equally erroneous; for they correspond not with those given by Zerenghi.]

The description and figures of the hippopotamus, which Prosper Alpinus published more than a hundred years after, are still worse than those of Columna, having been drawn from ill preserved skins; and M. Jussieu, who wrote upon the hippopotamus in the year 1724, has only described the bones of the head and feet.

By comparing these descriptions, and especially that of Zerenghi, with the information derived from travellers, it appears that the hippopotamus is an animal whose body is longer, and as thick as that of the rhinoceros; that his legs are much shorter; that his head is not so long, but larger in proportion to his body; that he has no horns, either on the nose, like the rhinoceros, or on the head, like the ruminating animals.

[In the river Nile there are *hippopotami* or *sea-horses*. In the year 1658 one of them was taken at Girge. It was soon brought to Cairo, where I saw it in the month of February of the same year; but it was dead. This animal was of a kind of tawny colour. Behind he resembled the buffalo; but his legs were shorter and thicker. He was as tall as a camel. His muzzle resembled that of an ox; but his body was twice as large. His head was similar to that of a horse, but larger. His eyes were small, his neck very thick, his ears small, his nostrils very large and open, his feet very large, almost round, with four toes on each, like those of the crocodile, and his tail small. Like the elephant he had little or no hair on the skin. In the under jaw he had four large teeth, about half a foot in length. Two of them were crooked, and as thick as the horns of an ox. At first he was mistaken for a sea buffalo. But I and some others, who had read descriptions of this animal, knew it to be a sea horse. It was brought dead to Cairo by the janissaries, who shot it on land, where it had come to feed. They poured several shots into it before it fell; for, as I formerly remarked, a musket ball hardly pierces its skin. But one ball entered its jaw, and brought it to the ground. None of these animals had been seen at Cairo for a long time.—*Thevenot.*]

As the cry uttered by the hippopotamus when pained is composed, according to ancient authors and modern travellers, of the neighing of a horse and the bellowing of a buffalo, his ordinary voice may perhaps resemble the neighing of a horse, from which, however, he differs in every other respect. If this be the case, we may presume that the animal has obtained the name *hippopotamus*, which signifies the *river horse*, solely from the similarity of his voice to that of a horse; in the same manner as the lynx, from his howling like a wolf, obtained the appellation of *lupus cervarius*. The cutting, and particularly the canine teeth of the lower jaw, are very long, and so hard and strong, that they strike fire with steel. This circumstance, it is probable, gave rise to the fable of the ancients, that the hippopotamus vomited fire from his mouth. The substance of the canine teeth is so white, so fine, and so hard, that it is preferable to ivory for making artificial teeth. [The finest and whitest teeth of the hippopotamus are found at Cape Mesurada in Africa. The dentists prefer them to ivory for making artificial teeth; because they are harder, whiter, and do not turn yellow so soon.—*Desmarchais.*] The cutting teeth, especially those of the under jaw, are very long, cylindrical, and chamfered.

The canine teeth are also long, crooked, prismatic, and sharp, like the tusks of the wild boar. The grinders are square or oblong, like those of man, and so large that a single tooth weighs more than three pounds. The largest cutting and canine teeth are twelve, and sometimes sixteen inches long, and each of them weighs from twelve to thirteen pounds.

In fine, to give a just idea of the magnitude of the hippopotamus, we shall employ the measures of Zerenghi, and augment them one third; because these measures were taken from the female, which was one third less than the male in all its dimensions. This male hippopotamus was of course sixteen feet nine inches long, from the extremity of the muzzle to the origin of the tail, fifteen feet in circumference, and six feet and a half high; and the legs were about two feet ten inches long. The head was three feet and a half in length, and eight feet and a half in circumference. The opening of the mouth was two feet four inches; and the largest teeth were more than a foot long.

With such powerful arms, and such prodigious strength of body, the hippopotamus might render himself formidable to all other animals. But he is naturally mild; besides, he is so heavy and slow in his movements that he could not overtake any quadruped. He swims faster than he runs; and he pursues fishes and preys upon them. Though he delights in the water, and lives in it as freely as upon land; yet he has not, like the beaver or otter, membranes between his toes. The great size of his belly renders his specific gravity nearly equal to that of water, and makes him swim with ease. Besides, he continues long at the bottom of the water, where he walks as in the open air; and when he comes out of it to pasture, he eats sugar canes, rushes, millet, rice, roots, &c. of which he consumes great quantities, and does much damage in the cultivated fields. But as he is more timid on land than in the water, it is not difficult to drive him off. His legs are so short that when at a distance from water he cannot escape by flight. When in danger his only resource is to plunge into the water, and travel under it a great way before he again appears. When hunted he generally flies; but when wounded he returns with fury, darts boldly against the boats, seizes them with his teeth, tears pieces off them, and sometimes sinks them. 'I have known,' says a traveller, 'the hippopotamus open his mouth, and set one tooth 'on the gunnel of a boat, and another on the second 'strake from the keel (which was more than four feet 'distant) and there bit a hole through the plank, and 'sunk the boat; and after he had done, he went away 'shaking his ears. His strength is incredibly great; for 'I have seen him, in the wash of the shore, when the sea 'has tossed in a Dutchman's boat, with fourteen hogs-'heads of water in her, upon the said beast, and left it 'dry on its back; and another sea came and fetched the 'boat off, and the beast was not hurt, as far as I could 'perceive. How his teeth grow in his mouth I could 'not see; only that they were round like a bow, and 'about sixteen inches long; and in the biggest part 'more than six inches about. We made several shot at 'him; but to no purpose, for they would glance from 'him as from a wall. The natives call him *kittimpungo*, 'and say he is *Tetisso*, which is a kind of god; for no-'thing, they say, can kill him: and if they should do 'to him as the white men do, he would soon destroy 'their canoes and fishing nets. Their custom is, when 'he comes near their canoes to throw him fish; and 'then he passeth away, and will not meddle with their 'fishing craft. He doth most mischief when he can 'stand on the ground; but when afloat hath only 'power to bite. As our boat once lay near the shore, I 'saw him go under her, and with his back lift her out 'of the water, and overset her with six men aboard; but 'as it happened, did them no harm. Whilst we lay in 'the road we had three of them, which did trouble this 'bay every full and change, and two or three days after. 'The natives say they go together, two males and one 'female. Their noise is much like the bellowing of a 'large calf.' These facts are sufficient to give an idea of the strength of this animal. Many similar facts are to be found in the General History of Voyages, by the Abbé Prevost, where we have a complete and judicious collection of all that has been delivered by travellers concerning the hippopotamus.

The individuals of this species are not numerous, and seem to be confined to the rivers of Africa. Most naturalists tell us, that the hippopotamus is also found in India. But the evidence they have of this fact appears to be equivocal. Alexander's letter to Aristotle would be the most positive, if we could be certain that the animals mentioned in it were really hippopotami; which to me seems very problematical; for if they were, Aristotle must have told us in his History of Animals that the hippopotamus was a native of India as well as of Egypt. Onesicritus and some old authors say, that the hippopotamus was found in the river Indus. But this fact has received no confirmation from modern travellers, at least from such of them as merit the greatest degree of credit: they all agree that the hippopotamus is found in the Nile, the Senegal or Niger, the Gambia, the Zaira, and the other great rivers and lakes of Africa, especially in the southern and eastern regions of that country. None of them say positively that this animal exists in Asia. Father Boym is the only one who seems to insinuate that the hippopotamus is found in Asia. But his relation appears to be suspicious, and in my opinion only proves that this animal is common in Mosambique and all the eastern parts of Africa. At present the hippopotamus, which the ancients call the *horse of the Nile*, is so rare in the lower Nile, that the inhabitants

of Egypt are totally ignorant of the name. He is equally unknown in all the northern parts of Africa, from the Mediterranean to the river Bambou, which runs at the foot of Mount Atlas. Hence the climate inhabited by the hippopotamus extends only from Senegal to Æthiopia, and from thence to the Cape of Good Hope.

As most authors mention the hippopotamus under the names of the *sea horse* or the *sea cow*, he has sometimes been confounded with the latter, which inhabits only the northern seas. It appears therefore to be certain, that the hippopotami, which the author of the Description of Muscovy says are found on the sea-shore near Petzora, are nothing else than sea-cows. Aldrovandus therefore merits reproach for adopting this opinion without examination, and maintaining that the hippopotamus is found in the north seas; for he not only does not inhabit the north seas, but it appears that he is rarely found in the south seas. The testimonies of Odoardus Barbosa and Edward Wotton, quoted by Aldrovandus, and which seem to prove that the hippopotamus inhabits the Indian seas, are nearly as equivocal as that of the describer of Muscovy; and I am inclined to think, with M. Adanson, that, now at least, the hippotamus is found only in the great rivers of Africa.

[In going up the Niger, we came to a quarter where the hippopotami or river horses are very common. This animal, which is the largest of the amphibious kind, is found only in the rivers of Africa, and in no other part of the world. He is generally said to be of the figure of an ox; and indeed he resembles that animal more than any other. But his legs are shorter, and his head is enormously large. With regard to size the hippopotamus may be ranked after the elephant and rhinoceros. His jaws are armed with four tusks, by which he tears up the roots of trees, which serve him for food. He cannot remain long under water without respiring, which obliges him to raise his head from time to time above the surface, like the crocodile.—*M. Adanson.*]

Kolbe, who says he saw several of them at the Cape of Good Hope, assures us, that they plunge equally into the sea and the rivers; and the same thing is advanced by other authors. Though Kolbe is more exact than usual in his description of this animal; yet it is doubtful whether he saw it so frequently as he insinuates; for the figure he gives is still worse than those of Columna, Aldrovandus, and Prosper Alpinus, which were all drawn from stuffed skins. It is easy to perceive that the descriptions and figures in Kolbe's works have not been taken on the spot, nor drawn from nature. His descriptions are written from memory, and most of the figures have been copied from those of other naturalists. The figure he has given of the hippopotamus has a great resemblance to the cheropotamus of Prosper Alpinus.

[If the epithet *sea* be applied to the hippopotamus or *sea horse*, it is not because he is a species of fish, or lives always *in the sea*. He comes upon the dry land in quest of food, and he retires for safety to the *sea* or to a *river*. Herbage is his ordinary food. When pressed with hunger he comes out of the water, in which he lies always in an extended posture. When he raises his head above the water he looks about on all sides to see if there is any danger, and he scents a man at a considerable distance. If he perceives any thing he plunges again into the water, where he continues three hours without moving. He generally weighs from two thousand five hundred to three thousand pounds. The sea horse, both in colour and size, resembles the rhinoceros, only his legs are somewhat shorter. His head, as Tellez remarks, has a greater resemblance to that of the horse than to that of any other animal; and from this circumstance he has derived his name. His mouth is much larger than that of the horse, and in this respect he approaches nearer the ox. His nostrils are very large; and when he rises to the surface of the river or sea, he squirts the water out of them. His ears and eyes are remarkably small. His legs are short, and of an equal thickness throughout. His hoofs are not divided into two, like those of the ox, but into four parts, on each of which there are spiral furrows. His tail is short like that of the elephant, with a few short hairs on it; and there is no hair on the rest of the body.

The paps of the female hang, like those of the cow, between the hind legs; but they, as well as the teats, are very small in proportion to the size of the animal. I have often seen the mothers suckling their young, which were then as large as sheep. The skin of the river horse is more than an inch thick, and so hard that it is difficult to kill him even with musket balls. The Europeans always aim at his head, where the skin is most tender, and easily pierced. This animal seldom receives a mortal wound in any other part of his body.

The teeth of the under jaw are very remarkable. They are four in number, two on each side, one of them crooked, and the other straight. They are as thick as an ox's horn, about a foot and a half long, and each of them weighs twelve pounds. They are very white, and never turn yellow with age, as ivory does. Hence they are more esteemed than the teeth of the elephant.

The flesh of this animal, whether boiled or roasted, is most delicious. It is so highly valued at the Cape as to sell at twelve or fifteen pence the pound. The fat sells as dear as the flesh: it is very mild and wholesome, and used instead of butter, &c.—*Kolbe.*]

Hence Kolbe, when he tells us that the hippopotamus inhabits the sea, has perhaps copied Pliny, instead of giving his own observations. Most authors relate that this animal is only found in fresh water lakes, and in rivers, sometimes near their mouths, but oftener at great

distances from the sea. Some travellers are astonished that the hippopotamus should have been called the *sea horse;* because, as Merollo remarks, this animal cannot endure salt water. He generally remains in the water during the day, and comes out in the night to pasture. The male and female seldom separate. Zerenghi caught a male and a female the same day, and in the same ditch. The Dutch voyagers tell us, that the female brings forth three or four young at a time. But this fact is rendered suspicious by the very evidence which Zerenghi quotes. Besides, as the hippopotamus is of an enormous size, like the elephant, the rhinoceros, the whale, and all other large animals, it must produce but one at a time: this analogy seems to be more certain than the vague reports of travellers.

SUPPLEMENT.

M. le Chevalier Bruce assured me that in his travels through Africa he saw a number of hippopotami in Lake Tzana, which is situated in Upper Abyssinia near the true sources of the Nile; and that in this lake, which is at least six leagues long by ten or twelve broad, the hippopotami are more numerous than in any other part of the world. He adds, that he saw some of them which were twenty feet long, with very thick short legs.

Addition to the article hippopotamus, by Professor Allamand, editor of the Dutch edition of this work.

To complete the description of the adult hippopotamus, given by M. de Buffon, nothing is wanting but a genuine figure of the animal. M. de Buffon, who is always original, chose not to copy the figures published by different authors. They are all too imperfect to be used; and with regard to the animal itself he could not possibly procure it. Even in its native country it is very rare, and too large to be transmitted without great expence and trouble. In the cabinet of natural curiosities in the university of Leyden, there is a stuffed skin of the hippopotamus, which had been sent from the Cape of Good Hope. Though it had been transported to Holland more than a century ago, it has been so well preserved, that it still exhibits an exact representation of the animal. It is supported by rings of iron, and by pieces of wood of such solidity, that drying has produced no considerable alterations. As it is probably the only specimen of the kind in Europe, I am persuaded that all lovers of natural knowledge will thank me for enriching the magnificent work of M. de Buffon with an exact engraving of it. The figure I have given represents the animal better than any that has hitherto been drawn, or rather, it is the only figure we have of it; for in all the others the hippopotamus is not distinguishable, if we except that to be found in a Dutch book concerning the Leviathan of Holy writ, which was copied from the same model; but the proportions of the animal are not accurately observed.

It is unnecessary to add a description of this enormous animal, having no additions to what has been said of it by M. de Buffon and M. Daubenton.

[As the figure of the young hippopotamus in the cabinet of the Prince of Conde differs from that which M. Allamand had engraved from the stuffed skin in the Leyden cabinet, and as it has a greater resemblance to a new figure given Dr. Klockner from another skin in the Prince of Orange's cabinet, I have here preferred the latter; and I shall add some remarks of the same author, which were translated from the Dutch.]

Addition to M. de Buffon's history of the hippopotamus, by Dr. Klockner of Amsterdam.

I am surprised that M. de Buffon takes no notice of a passage in Diodorus Siculus, concerning the hippopotamus, especially as this ancient author remarks, that its voice resembled the neighing of a horse, which perhaps induced him to give it the denomination of *hippopotamus* or *river horse.* M. de Buffon founded his opinion of this matter upon the testimonies of ancient and modern authors. Diodorus Siculus ought to have held the first rank among the former, since he not only travelled into Egypt, but is justly esteemed to be one of the best historians of antiquity. The following are the words of the passage alluded to: 'The Nile produces several 'animals, of which the crocodile and hippopotamus 'merit particular attention. The latter is five cubits in 'length. His feet are cloven like those of the ruminat-'ing animals; and in each jaw he has three tusks larger 'than those of the wild boar. The whole mass of his 'body resembles that of the elephant. His skin is 'harder and stronger than perhaps that of any other 'animal. He is amphibious, and remains during the 'day under the water, where he moves and acts in the 'same manner as if he were on land, which he visits in 'the night, in order to feed on the herbage of the 'mountains. If this animal were more prolific, he would 'commit great devastation in the cultivated fields of 'Egypt. The hunting of the hippopotamus requires a 'number of men, who endeavour to pierce him with 'iron daggers. They attack him with several boats 'joined together, and strike with crooked harpoons. To 'some of these hooks they fix a rope, and then leave 'the animal to exhaust itself with struggling and the 'loss of blood. His flesh is very hard, and of difficult 'digestion.'

This is perhaps the best description of the hippopotamus to be found among the ancients; for Diodorus commits not a single error but with regard to the number of the animal's toes.

Observations on the mode of preparing the skin of the hippopotamus, now in the Prince of Orange's cabinet, by Dr. Klockner.

I received from the Hague, in a very dry state, the skin of this hippopotamus, with the head inclosed within it. The skin had been first salted, then dried, and afterwards the skin of a young hippopotamus (which is likewise in the Prince's cabinet) steeped in brine, was in a moist state put into the adult skin. After which the whole was packed up in coarse cloth, and transmitted from the Cape of Good Hope to Holland. The small skin and the head of course produced a disagreeable odour of rancid grease, which attracted the insects, and they damaged the large skin that was first exposed to their attacks.

When I diluted the head it swelled greatly. The opening of the mouth was more than sixteen inches of Amsterdam measure. [The Amsterdam foot is only ten inches five lines of the French foot.] The upper and under lips were sufficiently large to cover all the animal's teeth, especially as the inferior canine teeth are crooked, and slip along the curvature of the superior, in the form of scissars, and pass into a socket formed by the skin of the lip and the gums. Between the cutting teeth and the cylindrical grinders, as well as between the tongue and cutting teeth, there is a smooth hard skin; and the palate is full of notches or hollows. The tongue had been cut out. The flesh on each side of the head had also been removed; and the fat which remained was corrupted. The whole however was interspersed with very strong muscles, and the flesh about the two lips was red and white, or of the colour of an ox's tongue.

Immediately behind the inferior canine teeth there is a protuberance, which, when the mouth is shut, fills the space between the canine teeth and grinders. This opening, though filled, has contracted one half in drying, as well as the lips.

Under the ears, and around the auditory passage, which is remarkably small, as well as in the orbits of the eyes, there was a great quantity of fat.

The ears are placed upon an eminence, and in such a manner as to form circular folds. The elevation of the right ear was much diminished in drying; but it was conspicuous on the left.

We know that the ears of the hippopotamus are very small. But those of our subject had been considerably diminished by insects. The internal part of the ears is garnished with fine close hair; but there is very little hair on the outside.

The eyes must have been very small; for the sockets were uncommonly small in proportion to the magnitude of the animal. The eyes I placed in my subject are perhaps larger than nature; but when I used smaller ones they did not seem to correspond with the animal.

The nostrils slope downward, and have a small aperture. They are afterwards joined internally by a small crooked line. When the skin was dry it was difficult to perceive these tubes. I enlarged them a little before the skin was again dried.

I must here remark, that I only found thirty-two teeth in this hippopotamus, which accords not either with Zerenghi's or M. Daubenton's descriptions. The first says, that he found forty-four teeth in his subjects; and the second found thirty-six in the head preserved in the royal cabinet. This difference excited my attention: but I could perceive no marks of teeth having fallen out except one of the cutting teeth, which seemed to have been broken. There are four canine teeth placed perpendicularly, eight cutting teeth, four in the upper jaw, which are perpendicular, and four in the under jaw, placed horizontally, as may be seen in the figure. Besides, I found two grinders in each side of the under jaw, and three teeth, placed before the grinders, which had the form of kayles. In each side of the upper jaw were three grinders, and two of these cylindrical teeth. Between these cylindrical teeth there is a space of about half an inch.

[I must here remark, says the Count de Buffon, that the hippopotamus has commonly thirty-six teeth, namely, four cutting teeth above, and four below, and two canine teeth and twelve grinders in each jaw. This observation has been verified by three heads, which have long remained in the royal cabinet, and by a fourth head, which was transmitted to me in the month of December, 1775, by M. de Sartine, secretary of state to the marine department. The last grinder, at the bottom of the mouth, is much thicker, broader, and flatter on the edge, than the other five. But I am inclined to think that the number of grinders varies according to the age of the animal; and that instead of twenty-four we may sometimes find twenty-eight, and even thirty-two, which, as Zerenghi remarks, would make forty-four in all.]

The upper and under lips, continues Dr. Klockner, are garnished at considerable distances with small tufts of hair, which, like pencils, proceed from one tube. I counted about twenty of them. I examined a section of one of these tubes with the microscope, and found seven roots issuing from one tube. These seven roots afterwards split, and each gave rise to several hairs, which formed a kind of pencil.

On the sides of the mouth, toward the lower part, I saw some fine hairs, which were placed nearer each other than the former.

Besides, I found here and there upon the body some scattered hairs; but there were none upon the legs, flanks, or belly.

The extremity and edges of the tail were garnished with pencils of hair, like the nose; but they were a little longer.

I could not discover the sex of this animal. Near the fundament there was a kind of triangular pinked aperture, about six inches wide, where I imagined the organs of generation had been situated; but as no vestige of them remained, it was impossible to ascertain the sex.

The skin of the belly, near the hind legs, was an inch and nine lines thick: here the insects had made a hole, which rendered it an easy matter to measure the thickness. The substance of the skin was white, cartilaginous, and coriaceous; and at this place it was well separated from the fat and flesh. Higher up, toward the back, a good deal of the skin had been pared off, with a view, no doubt, to render it lighter for carriage. It was for this reason that the skin about the spine exceeded not an inch in thickness.

The toes were furnished with nails. The skin between the toes was very wide; and I believe that the feet of this animal when alive were rather flat than round. The heel, which is placed high and backward, appeared to be well adapted for swimming. The hoof, though thick and hardened, was nevertheless flexible.

The dimensions of this animal were nearly the same with those of Zerenghi's female hippopotamus, formerly described.

I was told that this hippopotamus had advanced a great way upon land in the territories of the Cape, and even near the place called the *mountains of snow*, when it was shot by Charles Marais, a peasant of French extraction. This peasant brought the skin to M. de Piettenberg, governor of the Cape, who transmitted it to his Highness the Prince. I had the relation from a nephew of C. Marais, who resides in Amsterdam. According to the account given by this man, who had it from the mouth of Marais, the hippopotamus runs extremely swift, both in marshy places and on the firm ground. It is for this reason that the peasants, though excellent hunters, dare not fire upon him but when he is in the water. They lie in wait for him about sunset, when the animal raises his head above the water, and keeps his small ears in perpetual agitation, in order to hear if any noise is near. When any object of prey appears upon the water, he darts upon it like an arrow from a bow. While the hippopotamus is listening in this manner, and floating on the surface of the water, the hunters endeavour to shoot him in the head. The one whose skin I stuffed was shot between the eye and the right ear; and the young one, which is also in the Prince's cabinet, had been shot, or struck with an harpoon, in the breast, as appears from inspection. When he feels that he is wounded he plunges below the water, and walks or swims till he loses both motion and life. Then by means of about twenty oxen he is dragged on shore and dissected. An adult hippopotamus generally yields about two thousand pounds of fat, which is salted and sent to the Cape, where it sells very dear. This fat or lard is extremely good, and in relish excels all others. When pressed it yields a mild oil as white as cream. In Africa it is recommended as a sovereign remedy for diseases of the breast. The quantity of lard derived from an individual demonstrates that this animal is of a surprising weight and magnitude.

Before finishing my remark, I shall here add some particulars regarding the natural history of the hippopotamus, which are not to be found in the preceding description.

We have seen that the hippopotamus probably derived his name from the resemblance of his voice to the neighing of a horse. From the most authentic accounts, however, it appears that his cry has a greater similarity to that of the elephant, or to the stammering and indistinct sounds uttered by deaf persons. Beside this cry the hippopotamus when asleep makes a kind of snorting noise which betrays him at a distance. To prevent the danger arising from this circumstance, he generally lies among the reeds that grow upon marshy grounds, and which it is difficult to approach.

I can no where find the remark of Marais, concerning the agility of this animal, confirmed. We are perpetually assured, on the contrary, that the hunters choose rather to attack him on land than in the water, which indicates that they are not afraid of his swiftness. According to other historians his return to the river is cut off by trees and ditches; because they know that he uniformly inclines to regain the water, where he has no other animal to fear, rather than to fight or fly upon land. The great shark and the crocodile avoid the hippopotamus, and dare not engage with him.

The skin of the hippopotamus is so extremely hard on the back, the crupper, and the external parts of the thighs and buttocks, that neither arrows nor musket balls can pierce it. But it is softer and thinner on the inside of the thighs and belly, where the hunters endeavour to shoot him, or to pierce him with a javelin. He is extremely tenacious of life; and therefore they try to break his legs by large blunderbusses, charged with iron wedges. When they succeed, they are full masters of the animal. The Negroes, who attack the sharks and crocodiles with long knives and javelins, are afraid of the hippopotamus, and would perhaps never attempt to combat him unless they knew that they could outrun him. They believe, however, that this animal has a stronger antipathy to the whites than to the blacks.

The female brings forth on land, where she suckles her young, and soon teaches it to take refuge in the water, when the smallest noise is heard.

The Negroes of Angola, Congo, Elmina, and in general of the whole west coast of Africa, regard the hippopotamus as one of those inferior divinities which they call *Fetiches*. They scruple not, however, to eat his flesh when they can procure it.

THE ELK AND THE RAIN DEER.

THE elk has horns with short beams spreading into large and broad palms, one side of which is plain, the outmost furnished with several sharp snags. It has no brow antlers. The largest horn I have seen is in the house belonging to the Hudson's Bay company, and weighed 56 pounds. The length is 33 inches, between tip and tip 34, and the breadth of the palm 13½. There is in the same place an excellent picture of an elk which was killed in the presence of Charles XI. of Sweden, and weighed 1229 pounds. It is a very deformed and seemingly disproportioned beast. A young female of about a year old was to the top of the withers 5 feet or 15 hands. The head alone was two feet, and the length of the whole animal from nose to tail was about seven feet. The neck was much shorter than the head, with a short, thick, upright mane, of a light brown colour. The eyes were small, the ears one foot long, very broad and slouching, and the nostrils very large. The upper lip was square, hung greatly over the lower, and had a deep sulcus in the middle, so as to appear almost bifid. The nose was very broad. Under the throat was a small excrescence, from whence hung a long tuft of coarse black hair. The withers were very high, and the fore feet three feet three inches long. From the bottom of the hoof to the end of the tibia was two feet four inches. The hind legs were much shorter than the fore legs. The hoofs were much cloven; and the tail is very short, dusky above, and white beneath. The general colour of the body was a hoary black, but more gray above the face than any where else. This animal was living last spring at the Marquis of Rockingham's house, at Parson's-green.—*Pennant.*

The rain deer has large but slender horns, bending forward, the top palmated, brow antlers broad and palmated. Both sexes have horns; those of the female are less, and with fewer branches. A pair from Greenland were three feet nine inches long, two feet and a half from tip to tip, and weighed nine pounds twelve ounces. The height of a full grown rain deer is four feet six inches. The space round the eye is always black. When it first sheds its coat, the hairs are of a brownish ash colour, and afterwards change to white. The hairs are very close set together; and along the fore part of the neck they are very long and pendent. The hoofs are large, and the tail short.

Though the elk and rain deer are animals of different species, yet as it would be difficult to give the history of the one without encroaching on that of the other, we find it convenient to treat of them under one article. Most ancient as well as modern authors have confounded them, or exhibited them under equivocal denominations, which are equally applicable to both. The Greeks knew neither the elk nor the rain deer; for Aristotle makes no mention of them: and among the Latins Julius Cæsar is the first who employed the word *alce*. Pausanias, who wrote a century after Cæsar, is the first Greek author in which the name *alke* occurs; and Pliny, who was nearly contemporary with Pausanias, has given some obscure intimations of the elk and rain deer under the appellations of *alce*, *machlis*, and *tarandus*. The name *alce*, therefore, cannot be properly considered as either Greek or Latin; but it appears to have been derived from the Celtic language, in which the elk is called *elch* or *elk*. The Latin name of the rain deer is still more uncertain. Several naturalists have thought that it was the *machlis* of Pliny; because this author, when speaking of the northern animals, mentions at the same time the *alce* and the *machlis*; the last of which, he remarks, is peculiar to Scandinavia, and was never seen either at Rome, or any part of the Roman empire. In Cæsar's Commentaries, however, we find a passage which can apply to no other animal than the rain deer, and seems to prove that it then existed in the forests of Germany: and Gaston Phœbus, fifteen centuries after Julius Cæsar, seems to speak of the rain deer, under the name of *rangier*, as an animal which in his time existed in the forests of France. He has even given a good description of this animal, and of the manner of hunting it.

[The *rangier* or *ranglier* is an animal that resembles the stag; but his horns are larger and much more branched. When hunted he flies, on account of the great weight on his head. But after running long and doubling, he places his buttocks against a tree, to prevent any attack from behind, and bends his head toward the ground. In this situation the dogs dare not approach him, because his whole body is defended by his horns. If they come behind him, he strikes them with his heels. The greyhounds and bull-dogs are terrified when they see his horns. The rangier is not taller than the fallow deer; but he is much thicker. When he rears his horns backward, they cover his whole body. He feeds like the stag or fallow deer, and throws his dung in clusters. He lives very long. The hunters shoot him with arrows, or take him with different kinds of snares. He is fatter than a stag. Like the fallow deer he follows the stag in the rutting season.

As to the manner of hunting the *rangier* or *ranglier*; when the hunters go in quest of this animal, they should separate the dogs, to prevent his running into the thickest parts of the forest, which are inhabited by the fallow deer

and roebucks. He should separate his nets and snares according to the situation of the forest, and lead his hounds through the wood. As the horns of the rangier are high and heavy few hunters attempt to seize him with hounds.—*Dufouilloux.*]

As this description cannot apply to the elk, and as he gives at the same time the mode of hunting the stag, the fallow deer, the roebuck, the wild goat, the chamois goat, &c. it cannot be alledged, that under the article *rangier* he meant any of these animals, or that he had been deceived in the application of the name. It is apparent, therefore, from these positive evidences, that the rain deer formerly existed in France, especially in the mountainous parts, such as the Pyrenees, in the neighbourhood of which Gaston Phœbus resided, as lord of the county of Foix; and that since this period they have been destroyed, like the stags, which were formerly common in this country, and which now exist not in Bigore, Couserans, nor in the adjacent provinces. It is certain that the rain deer is found only in more northern latitudes. But we likewise know, that the climate of France was formerly much moister and colder, on account of the many forests and marshes which have since been cut down and drained. From the Emperor Julian's letter we learn what was the rigour of the frost at Paris in his time. The description he gives of the ice on the Seine is perfectly the same with what the Canadians tell us of the ice on the rivers of Quebec. Gaul, under the same latitude with Canada, was two thousand years ago exactly what Canada is at present, namely, a climate sufficiently cold to nourish animals which are now found only in the more northern regions.

From all these facts, therefore, it is evident, that the elk and the rain deer formerly existed in the forests of Gaul and Germany; and that the passages in the Commentaries of Cæsar can apply to no other animals. In proportion as the lands were cleared, and the waters dried up, the temperature of the climate would become more mild, these animals, who delight in cold, would first abandon the flat countries, and retire to the snowy mountains, where they still subsisted in the days of Gaston de Foix. The reason why they are no longer found there is obvious: the heat of the climate has been gradually augmented by the almost total destruction of the forests, by the successive lowering of the mountains, by the diminution of the waters, by the multiplication of the human race, and by culture and improvement of every kind. It appears likewise that Pliny has borrowed from Cæsar almost every thing he has said of these two animals, and that he was the first who introduced confusion into their names. The *alce* and the *machlis* he mentions at the same time; from which we are led to conclude that these two names denote two different animals. But if we consider, 1. That he mentions the *alce* only once, without giving any description of it; 2. That he alone employs the word *machlis*, which is neither Greek nor Latin, but seems to have been coined, and, according to his commentators, is changed into *alce* in several ancient manuscripts; that he attributes to the *machlis* all that Julius Cæsar has said of the *alce;* the passage of Pliny must unquestionably have been corrupted, and these two names must denote the same animal, namely, the *elk*. The decision of this question will resolve another. As the *machlis* is the *elk*, the *tarandus* must be the *rain deer*. The name *tarandus* is found in no other author before Pliny, and has given rise to various interpretations. Agricola and Elliot, however, have not hesitated to apply it to the rain deer; and, for the reason above assigned, we willingly subscribe to their opinion. Besides, we should not be surprised at the silence of the Greeks, nor at the ambiguity with which the Latins have mentioned these animals; since the northern regions were absolutely unknown to the former, and the latter had all their information concerning these regions from the relations of others.

Now in Europe and Asia the elk is found only on this side, and the rain deer beyond, the polar circle. In America we meet with them in lower latitudes; because there the cold is greater than in Europe. The rain deer, being able to endure the most excessive cold, is found in Spitzbergen; he is also very common in Greenland, and in the most northern regions of Lapland and of Asia.

[Captain Craycott, in the year 1738, brought a male and a female rain deer from Greenland to London;—*Edwards's Hist. of Birds*, p. 51, where we have a description and figure of this animal under the name of the *Greenland fallow deer*, which, as well as the *Greenland roebuck*, or *caprea Groenlendica*, mentioned by Grew, in his description of the museum of the royal royal society, can be nothing else but the rain deer. Both these authors, in their descriptions, mention as a peculiar character, the down with which the horns of these animals were covered. This character, however, is common to the rain deer, the stag, the fallow deer, and all the deer kind. This hair or down continues on the horns during the summer season, which is the time when they are growing, and the only time that vessels can sail to Greenland. It is not, therefore, surprising that during this season the horns of the rain deer should be covered with down. Hence this character is of no importance in the descriptions given by these authors.

Upon the coasts of Frobisher's Straits there are stags nearly of the colour of asses, and whose horns are higher and much larger than those of our stags. Their feet are from seven to eight inches in circumference, and resemble those of our oxen.—*Lade's Voy. tom.* ii. *p.* 297. *Note.* This passage seems to have been copied from Captain Martin's Voyage, p. 17, where he remarks, 'There are great numbers of stags on the lands off

'Warwick road, the skin of which resembles that of our 'asses. Their head and horns, both in length and 'breadth, surpass those of our stags. Their foot is as 'large as that of an ox, being eight inches broad.'

The rain deer are numerous in the country of the Samoiedes, and over all the north.—*Olearius.*]

The elk approaches not so near the pole, but inhabits Norway, Sweden, Poland, Lithuania, Russia, and Siberia and Tartary, as far as the north of China. [The Tartarian animal, called *han-ta-han* by the Chinese, appears to be the same with the elk. 'The han-ta-han,' say the missionaries, 'is an animal which resembles the elk. 'The hunting of it is a common exercise in the country 'of the Solons, and the Emperor Kam-hi sometimes 'partakes of this amusement. There are han-ta-hans as 'large as our oxen. They are only found in particular 'cantons, especially toward the mountains of Sevelki, 'in marshy grounds, which they are fond of, and where 'they are easily hunted, because their weight retards 'their flight.—*Hist. Gen. des Voyages.*]

In Canada, and in all the northern parts of America, we meet with the elk under the name of the *orignal*, and the rain deer under that of *caribou*. Those naturalists who suspect that the orignal is not the elk, and the caribou the rain deer, have not compared nature with the relations of travellers. Though smaller, like all the other American quadrupeds, than those of the Old Continent, they are unquestionably the same animals.

[The *elks* or *orignals* are frequent in the province of Canada, and very rare in the country of the Hurons; because these animals generally retire to the coldest regions. The Hurons call the elks *sondareinta*, and the caribous *qusquoy*, of which the Savages gave us a foot, which was hollow, and so light, that it is not difficult to believe what is said of this animal, that he walks on the snow without making a track. The elk is taller than a horse. His hair is commonly gray, sometimes yellow, and as long as a man's finger. His head is very long, and he has double horns, like the stag. They are as broad as those of the fallow deer, and three feet in length. His foot is cloven, like that of the stag, but much larger. His flesh is tender and delicate. He pastures in the meadows, and likewise eats the tender twigs of trees. Next to fish he is the principal food of the Canadians.—*Sagard Theodat.*

We find in New England great numbers of *orignals* or *elks*. The island Cape Breton was famous for the chase of the orignal, where they were very numerous; but they have since been extirpated by the Savages. The orignal of New France is as strong as a mule; his head is nearly of the same shape. His neck is longer, and his whole body more meagre. His limbs are long and nervous. His foot is cloven, and his tail is very short. Some of them are gray, others reddish or black, and when old their hair is hollow, as long as a man's finger, and makes excellent mattresses, or ornaments for saddles. The elk has large, flat, palmated horns. Some of them are a fathom long, and weigh from a hundred to a hundred and fifty pounds. They shed, like those of the stag.—*Descript. de l'Amerique Septent. par Denys.*

The orignal is a species of elk, very little different from those we see in Muscovy. He is as large as a mule, and of a similar figure, except in the muzzle, the tail, and the large flat horns, which, if we may credit the Savages, sometimes weigh three hundred and even four hundred pounds. This animal commonly frequents open countries. His hair is long and of a brown colour. His skin, though not thick, is very strong and hard. His flesh is good, but that of the female is most delicate.—*La Hontan.*

The caribou is an animal with a large muzzle and long ears. As his foot is broad, he runs with ease over the hardened snow, which distinguishes him from the orignal, whose feet always sink.—*Idem.*

The island of Saint John is situated in the great bay of Saint Lawrence. There are no orignals in this island; but there are caribous, which seem to be another species of orignal. Their horns are not so strong; their hair is thinner and longer, and almost entirely white. Their flesh is whiter than that of the orignal, and makes excellent eating.—*Denys.*

The caribou is not so tall as the orignal, and its figure partakes more of the ass than of the mule, and equals the stag in fleetness. Some years ago one of them was seen on Cape Diamond, above Quebec. The tongue of this animal is much esteemed. His native country seems to be in the neighbourhood of Hudson's Bay.—*P. Charlevoix.*

The finest hunting in North America is that of the caribou. It continues the whole year; and particularly in spring and autumn we see them in troops of above three or four hundred at a time. The horns of the caribou resemble those of the fallow deer. When first seen by our sailors they were afraid and ran from them.—*Lettres edifiantes recueil.*]

We will acquire juster ideas of the elk and rain deer by comparing both with the stag: the elk is taller, thicker, and stands higher on his legs; his neck is also shorter, his hair longer, and his horns much longer than those of the stag. The rain deer is not so tall; his limbs are shorter and thicker, and his feet much larger. His hair is very bushy, and his horns are longer, and divided into a great number of branches, each of which is terminated by a palm: but those of the elk have the appearance of being cut off abruptly, and are furnished with broaches. Both have long hair under the neck, short tails, and ears much longer than those of the stag. Their motion consists not of bounds or leaps, like the stag and roebuck: it is a kind of trot, but so quick and nimble, that they will pass over nearly the

same ground in an equal time, without being fatigued; for they will continue to trot in this manner during a whole day, or even two days. The rain deer keeps always on the mountains; and the elk inhabits low grounds and moist forests. Both go in flocks like the stag; and both may be tamed; but the rain deer is more easily tamed than the elk. The latter, like the stag, has never lost its liberty. But the rain deer has been rendered domestic by the most stupid of the human race. The Laplanders have no other cattle. In this frozen climate, which receives only the most oblique rays of the sun, where the night and the day constitute two seasons, where the earth is covered with snow from the beginning of autumn to the end of spring, where the bramble, the juniper, and the moss, constitute the only verdure of the summer, man can never hope to nourish cattle. The horse, the ox, the sheep, and all our other useful animals, could never find subsistence there, nor be able to resist the rigours of the frost. It would have been necessary to select from the deepest forests those species of animals which are least wild and most profitable. The Laplanders have actually done what we would be obliged to do, if all our cattle were destroyed. To supply their place it would then be necessary to tame the stags and roebucks of our woods, and to render them domestic. This end, I am persuaded, might be easily accomplished; and we should soon derive as much benefit from these animals as the Laplanders do from their rain deer. This example should lead us to admire the unbounded liberality of Nature. We use not one half of the treasures she presents to us; for her resources are inexhaustible. She has given us the horse, the ox, the sheep, and other domestic animals, to serve, to nourish, and to clothe us; and she has other species still in reserve, which might supply the want of the former; these we have only to subdue, and to render them subservient to our purposes. Man is equally ignorant of the powers of Nature, and of his own capacity to modify and improve her productions. Instead of making new researches, he is continually abusing the little knowledge he has acquired.

By estimating the advantages the Laplanders derive from the rain deer, we shall find that this animal is worth two or three of our domestic animals. They use him as a horse in drawing sledges and carriages. He is so nimble and expeditious, that in one day he performs with ease a journey of thirty leagues, and runs with equal sureness on the frozen snows as upon the finest downs. The milk of the female affords a more substantial nourishment than that of the cow. The flesh of this animal is exceedingly good. His hair makes excellent furs; and his skin is convertible into very strong and pliant leather. Thus the rain deer alone furnishes every article we derive from the horse, the ox, and the sheep.

The manner in which the Laplanders rear and manage the rain deer merits particular attention. Olaus, Scheffer, and Regnard, have given interesting details on this subject, of which the following is an abridgment. These authors tell us, that the horns of the rain deer are much larger, and divided into a greater number of branches than those of the stag. During winter the food of this animal is a white moss, which he knows how to find under the deepest snow, by digging with his horns, and turning it aside with his feet. In summer he prefers the buds and leaves of trees to herbs, which the projecting branches of his horns permit him not to browse with ease. He runs on the snow, into which the breadth of his feet prevents him from sinking. These animals are extremely gentle, and are kept in flocks, which bring great profits to their owners. The milk, the skin, the sinews, the bones, the hoofs, the horns, the hair, the flesh, are all useful articles. The richest Laplanders have flocks of four or five hundred; and the poorest have ten or twelve. They are led out to pasture, and during the night they are shut up in inclosures, to protect them from the wolves. When carried to another climate they soon die. Steno, Prince of Sweden, sent some of them to Frederic, Duke of Holstein; and more recently, in the year 1633, Gustavus, King of Sweden, transmitted to Prussia ten male and female rain deer, which were let loose in the woods. They all perished without producing, either in the domestic or free state. 'I had a great desire,' says M. Regnard, 'to carry some 'live rain deer to France. This experiment has been 'frequently tried in vain. Last year some of them were 'brought to Dantzick, where, being unable to endure 'the heat of that climate they perished.'

In Lapland there are both wild and domestic rain deer. During the rutting season the females are let loose into the woods, where they meet with wild males; and as the latter are stronger and more hardy than the domestic kind, the breed from this commixture is better adapted for drawing sledges. These rain deer are not so mild as the others; for they sometimes not only refuse to obey their master, but turn against him, and strike him so furiously with their feet, that his only resource is to cover himself with his sledge till the rage of the animal abates. This carriage is so light that a Laplander can turn it with ease above himself. The bottom of it is covered with the skins of young rain deer, the hair of which is turned backward, to make the sledge advance easily up the mountains, and to prevent its recoiling. The rain deer is yoked by means of a collar, made of a piece of skin with the hair on it, from which a trace is brought under the belly between the legs, and fixed to the fore part of the sledge. The only rein used by the Laplander is a cord tied to the root of the animal's horn, which he sometimes lays upon the one side of its back, and sometimes on the other, according as he wants it to turn to the right or the left. The rain deer

can travel in this manner at the rate of four or five leagues in an hour. But the quicker he goes the motion becomes the more incommodious; and it requires much practice to be able to sit in the sledge, and to prevent it from overturning.

Externally the rain deer have many things in common with the stag; and the structure of their internal parts is nearly the same. From this natural conformity many analogous habits and similar effects result. Like the stag, the rain deer annually casts his horns, and is loaded with fat. The rutting season of both is about the end of September. The females of both species go eight months with young, and produce but one fawn. During the rutting season the males have an equally disagreeable odour; and some of the female rain deer, as well as the hinds, are barren. The young rain deer, like the fawns of the stag, are variously coloured, being first red mixed with yellow, and afterwards become of a blackish brown colour. The young follow their mothers two or three years; and they acquire not their full growth till the end of the fourth year. It is at this age also that they are trained to labour. At the age of one year they are castrated in order to make them tractable. The Laplanders perform this operation with their teeth. The uncastrated males are fierce and very difficult to manage; and therefore are not used for labour. To draw their sledges the most active and nimble geldings are selected, and the heaviest are employed in carrying provisions and baggage. One unmutilated male is kept for every five or six females. Like the stags, they are tormented with worms in the bad season. About the end of winter such vast numbers are engendered under their skin that it is as full of holes as a sieve. These holes made by the worms close in summer; and it is only in autumn that the rain deer are killed for their fur or their hide.

The flocks of rain deer require much attention. They are apt to run off, and to assume their natural liberty. They must be followed, and narrowly watched, and never allowed to pasture but in open places. When the flock is numerous, the assistance of several persons is necessary to keep them together, and to pursue those which run off. In order to distinguish them when they wander into the woods, or mingle with other flocks, they are all marked. In fine, the time of the Laplanders is totally consumed in the management of their rain deer, which constitute their whole riches, and they know how to derive all the conveniencies, or rather the necessities of life, from these animals. They are covered from head to foot with their furs, which are impenetrable either by cold or water. This is their winter habit. In summer they use the skins from which the hair is fallen off. They likewise spin the hair, and cover the sinews they extract from the animal's body with it. These sinews serve them for ropes and thread. They eat the flesh, and drink the milk, of which last they also make very fat cheese. The milk, when churned, instead of butter, produces a kind of suet. This singularity, as well as the great extent of the horns, and the fatness of the animal at the commencement of the rutting season, are strong indications of a redundance of nourishment. But we have still farther proofs that this redundance is excessive, or at least greater than in any other species; for it is peculiar to the rain deer alone, that the female has horns as well as the male, and that even when the males are castrated they annually shed and renew their horns. In the stag, the fallow deer, and the roebuck, who have undergone this operation, the horns remain always in the same condition they were at the time of castration. Thus of all other animals the rain deer affords the most conspicuous example of redundant nutritive matter; and this effect is perhaps less owing to the nature of the animal than to the quality of his food; for the substance of the *lichen*, or raindeer liverwort, which is its only nourishment, especially during the winter, is similar to that of the mushroom, very nourishing, and contains a greater number of organic particles than the leaves or buds of trees. This is the reason why the rain deer has larger horns and a greater quantity of fat than the stag, and why the females and geldings are not deprived of horns: it is also the reason why the horns of the rain deer are more diversified in size, figure, and number of branches, than any other of the deer kind. Those males who have never been hunted or restrained, and who feed plentifully and at their ease upon this substantial nourishment, have prodigious horns, which extend backward as far as their crupper, and forward beyond the muzzle. The horns of the castrated males, though smaller, often exceed those of the stag; and those of the females are still smaller. Thus the horns of the rain deer are not only subject to variation from age, like others of the deer kind, but from sex and castration. These differences are so great in the horns of different individuals, that it is not surprising to see the descriptions given of them by authors so exceedingly different.

[It is remarkable that though the rain deer eats nothing during winter but great quantities of this moss, he always fattens better, his skin is cleaner, and his hair finer than when he feeds upon the best herbage, at which time he makes a hideous appearance. Their being unable to endure heat is the reason why they are better and fatter in autumn and winter than in summer, when they have nothing but sinews, skin, and bone.—*Scheffer.*]

Another singularity, which is common to the rain deer and the elk, must not be omitted. When these animals run, though not at full speed, their hoofs at each movement make a crackling noise, as if all their limbs were disjointed. The wolves, advertised by this noise, or by the odour of the animal, throw themselves in his way, and if numerous they seize and kill him;

for a rain deer defends himself against the attacks of a single wolf. For this purpose he employs not his horns, which are more hurtful than useful to him, but his fore feet, which are very strong. With these he strikes the wolf so violently as to stun him, or make him fly off; and afterwards runs with a rapidity that prevents all further attacks. The *rosomack* or *glutton*, though not so numerous, is a more dangerous enemy. This animal is still more voracious, but not so nimble as the wolf. He pursues not the rain deer, but lies in wait for it concealed in a tree. As soon as the rain deer comes within his reach, he darts down upon it, fixes upon its back with his claws; and tearing its head or neck with his teeth, he never quits his station till he has cut the animal's throat. He employs the same artifices, and carries on the same war against the elk, which is still stronger than the rain deer. This *rosomack* or *glutton* of the North is the same animal with the *carcajou* or *quincajou* of North America. His combats with the orignal of Canada are famous; and, as formerly remarked, the orignal of Canada is the same with the elk of Europe. It is remarkable that this animal, which is not larger than a badger, should kill the elk, which exceeds the size of a horse, and is so strong as to slay a wolf with a single stroke of his foot. But this fact is attested by such a number of authorities as render it altogether unquestionable.

[There is another animal, of a grayish brown colour, and about the size of a dog, which carries on a bloody war against the rain deer. This animal, which the Swedes call *jaert*, and the Latins *gulo*, conceals itself in the highest trees, in order to surprise its prey. When he discovers a rain deer, whether wild or domestic, passing under the tree where he is watching, he darts down upon its back, and fixing his claws in the neck and tail, he tears and stretches with such violence as to break the animal's back, then sinks his muzzle into its body, and drinks its blood. The skin of the jaert is very fine and beautiful, and has even been compared to that of the sable.—*Regnard.*

The caribou runs upon the snow almost as nimbly as upon the ground; because the broadness of its feet prevents it from sinking. The caribou, like the orignal, travels through the forests in winter, and is attacked in the same manner by the carcajou.—*Hist. de l'Acad. des Sciences, ann.* 1713. *Note*—The carcajou is the same animal with the *jaert* or *glutton*.]

The elk and the rain deer are both ruminating animals, as appears from their manner of feeding, and the structure of their intestines; yet Tornæus Scheffer, Regnard, Hulden, and several other authors, have maintained that the rain deer does not ruminate. Ray, with much propriety, considers this opinion as incredible; and, in fact, the rain deer chews the cud as well as all other animals which have many stomachs. The duration of life in the domestic rain deer exceeds not fifteen or sixteen years. But it is probable, that in a wild state he lives much longer; for, as he is four years in acquiring his full growth, he ought when in his natural state to live twenty-eight or thirty years. The Laplanders employ different methods of hunting the wild rain deer, corresponding to the difference of seasons. In the rutting time they use domestic females to attract wild males. They shoot these animals with muskets or with bows, and they let fly their arrows with such violence, that notwithstanding the thickness and strength of their skin one is generally fatal.

[The Laplanders hunt the rain deer with nets, halberds, arrows, and muskets. The hunting seasons are autumn and spring. In autumn, when the rain deer are in season, the Laplanders go to those places of the forests which they know the wild males frequent, and there tie domestic females to the trees. The female attracts the male, and when he is at the point of covering her, the hunter shoots him with a bullet or an arrow. In spring, when the snow begins to melt, and these animals are embarrassed by sinking in it, the Laplander, shod with his rackets, pursues and overtakes them. At other times they are chased into snares by dogs. In fine, a kind of nets are employed, which are composed of stakes wattled together in the form of two hedges, with an alley between them of perhaps two leagues in length. When the rain deer are pushed into this alley, they run forward and fall into a large ditch made with that view at the end of it.—*Scheffer.*]

We have collected the facts relating to the history of the rain deer with the more care and circumspection, because it was not possible for us to procure the live animal. Having expressed my regret on this subject to some of my friends, Mr. Collinson, member of the Royal Society of London, a man as respectable for his virtues as for his literary merit, was so obliging as to send me a drawing of the skeleton of a rain deer; and I received from Canada a fœtus of a caribou. By means of these two, and of several horns which were transmitted to us from different places, we have been enabled to mark the general resemblances and principal differences between the rain deer and the stag.

With regard to the elk I saw one alive about fifteen years ago. But as it continued only a few days in Paris, I had not sufficient time to have the drawing completed; and therefore I was obliged to content myself with examining the description formerly given of this animal by the gentlemen of the academy, and to be satisfied that it was exact, and perfectly conformable to nature.

'The elk,' says the digester of the Memoirs of the Academy, 'is remarkable for the length of its hair, the 'largeness of its ears, the smallness of its tail, and the 'form of its eye, the largest angle of which is much split, 'as well as the mouth, which is much larger than that

'of the ox, the stag, or other cloven footed animals. 'The elk which we dissected was nearly of the size of a 'stag. The length of the body was five feet and a half 'from the end of the muzzle to the origin of the tail, 'which was only two inches long. Being a female it 'had no horns; and its neck was only nine inches in 'length, and as much in breadth. The ears were nine 'inches long by four broad. The colour of the hair was 'not much different from that of the ass, the gray colour 'of which sometimes approaches to that of the camel. 'In other respects this hair differed greatly from that of the ass, which is shorter, and from that of the camel, 'which is much finer. The length of the hair was three 'inches, and equalled in thickness the coarsest hair of 'a horse. This thickness diminished gradually toward 'the extremity, which was very sharp: it diminished 'likewise toward the root, but suddenly became like the 'handle of a lancet. This handle was of a different co-'lour from the rest of the hair, being white and dia-'phonous, like the bristles of a hog. The hair was as 'long as that of a bear, but straighter, thicker, smoother, 'and all of the same kind. The upper lip was large and 'detached from the gums, but by no means so large as 'Solinus described it, nor as Pliny has represented the 'animal he calls *machlis*. These authors tell us, that 'this creature is obliged to go backward when he pas-'tures, to prevent his lip from being entangled between 'his teeth. We remarked, in the dissection, that nature 'had provided against this inconveniency by the large-'ness and strength of the muscles destined to raise the 'upper lip. We likewise found the articulations of the 'legs closely embraced by ligaments, the hardness and 'thickness of which might give rise to the opinion, that 'the *alce*, after lying down, was unable to raise himself. 'His feet were similar to those of the stag; only they 'were larger, and had no other peculiarity. We remarked 'that the large angle of the eye was much more slit 'below than in the stag, the fallow deer, and the roe-'buck: it is singular, that this slit was not in the direc-'tion of the opening of the eye, but made an angle with 'the line which goes from the one corner of the eye to the 'other; the inferior lachrymal gland was an inch and a 'half long by seven lines broad. In the brain we found 'a part whose magnitude seemed to point out some 'relation to the sense of smelling, which, according to 'Pausanias, is more exquisite in the elk than in any 'other animal; for the olfactory nerves, commonly 'called the *mamillary processes*, were incomparably larger 'than in any other animal we ever dissected, being more 'than four lines in diameter. With regard to the lump 'of flesh which some authors have placed on his back, 'and others under his chin, if they have not been de-'ceived or too credulous, it must be peculiar to the elks 'they mention.' We can add our testimony to that of the gentlemen of the Academy; for in the female elk we had alive there was no bunch either under the chin or on the neck. Linnæus, however, as he lives in the country inhabited by elks, and ought to have a more complete knowledge of them than we can pretend to, mentions this bunch on the neck, and even makes it an essential character of the elk. There is no other method of reconciling the assertion of Linnæus with our negative evidence, but by supposing this bunch, *guttural caruncle*, to be peculiar to the male, which we have never seen. But though this were the case, Linnæus ought not to have made it an essential character of the species, since it exists not in the female. This bunch may likewise be a disease, a kind of wen, common among the elks; for in Gessner's two figures of this animal, the first, which wants horns, has a large fleshy bunch on the throat; and in the second, which represents a male with his horns, there is no bunch.

In general the elk is much larger and stronger than the stag or rain deer. His hair is so rough, and his skin so hard, that it is hardly penetrable by a musket ball. His limbs are extremely firm, and possess such agility and strength, that with a single blow of his fore feet he can slay a man, or a wolf, and even break a tree.

[The elk exceeds the rain deer in magnitude, being equal to the largest horse. Besides, the horns of the elk are much shorter, about two palms broad, and have very few branches. His feet, especially those before, are not round, but long, and he strikes with them so furiously as to kill both men and dogs. Neither does he more resemble the rain deer in the form of his head, which is longer, and his lips are large and pendulous. His colour is not so white as that of the rain deer, but over the whole body it is an obscure yellow, mixed with a cinereous gray. When he moves he makes no noise with his joints, which is common to all rain deer. In fine, whoever examines both animals, as I have often done, will remark so many differences, that he will have reason to be surprised how any man should regard them as the same species.—*Scheffer.*]

The elk is hunted by men and dogs, in the same manner as the stag. We are assured, that when pursued he often falls down suddenly, without being either shot or wounded. From this circumstance it has been presumed that the animal is subject to the epilepsy; and from this presumption (which is not well founded, since fear might produce the same effect) the absurd conclusion has been drawn, that his hoofs have the power of curing, and even preventing the falling sickness. This gross prejudice has been so generally diffused, that many people still carry pieces of the elk's hoof in the collets of their rings.

[We had not advanced a pistol shot into the wood, when we descried an elk, which, when running before us, suddenly dropped down, without being so much as fired at. We asked our guide and interpreter how the

animal came to fall in this manner. He replied, that it was the falling sickness, to which these animals are subject, and assigned that as the reason of their being called *ellends*, which signifies *miserable*. If this disease did not often bring them down, it would be difficult to seize them. The Norwegian gentleman killed this elk while it was under the influence of its disease. We pursued another two hours, and would never have taken him, if he had not, like the first, fallen down, after having killed three strong dogs with his fore feet. The gentleman presented me with the left hind feet of the elks he had killed, and told me they were a sovereign remedy against the falling sickness. To which I answered, smiling, that since this foot had so much virtue, I was surprised that the animal to which it belonged should ever be afflicted with the disease. The gentleman likewise laughed, and said that I was right; that he had seen it administered without effect to many people who were troubled with the epilepsy; and that he knew, as well as I did, that it was a vulgar error.—*Martiniere.*]

As the northern parts of America are very thinly inhabited, all the animals, and particularly the elks, are more numerous there than in the north of Europe. The Savages are not ignorant of the art of hunting and seizing the elks. They sometimes follow the track of these animals for several days, and by mere perseverance and address accomplish their purpose. Their mode of hunting in winter is particularly singular. 'They use,' says Denys, 'rackets, by means of which they walk on the 'snow without sinking. The orignal does not make much 'way, because he sinks in the snow, which fatigues 'him. He eats only the annual shoots of trees. Where 'the Savages find the wood eaten in this manner, they 'soon meet with the animals, which are never very dis-'tant, and are easily taken, because they cannot run ex-'peditiously. They throw darts at them, which consist 'of large staves pointed with a bone, which pierces like 'a sword. When there are many orignals in a flock, the 'Savages put them to flight. The orignals, in this case, 'march at one another's tails, and make a circle some-'times of more than two leagues, and by their frequent 'turning round tread the snow so hard that they no 'longer sink in it. The Savages lie in ambuscade, and 'kill the animals with darts as they pass.' From comparing this relation with those already quoted, it is apparent, that the American Savage and the orignal are exact copies of the European Laplander and the elk.

SUPPLEMENT.

Addition to the article elk and rain deer, by Professor Allamand.

M. de Buffon is of opinion that the European elk is likewise found in North America under the appellation of *orignal*. If any difference exists, it consists in magnitude only, which varies in proportion to climate and food. It is not even ascertained which of them are largest. M. de Buffon thinks that those of Europe are larger than those of America, because all the animals of the New Continent are smaller than those of the Old. Most voyagers, however, represent the orignal as exceeding the elk in magnitude. Mr. Dudley, who sent an accurate description of an orignal to the Royal Society, says, that the hunters killed one which was more than ten feet high. This stature would be necessary to enable the animal to carry its enormous horns, which weigh one hundred and fifty, and, if we believe La Hontan, three or four hundred pounds.

The Duke of Richmond, who delights in collecting for public utility every thing that can contribute to improve the arts, or augment our knowledge of nature, has a female orignal in one of his parks, which was conveyed to him by General Carleton, governor of Canada, in the year 1766. It was then only one year old, and it lived nine or ten months. Some time before it died he caused an exact drawing of it to be made, which he obligingly sent to me, and of which I have given an engraving as a supplement to M. de Buffon's work. As this female was very young, it exceeded not five feet in height. The colour of the upper part of the body was a deep brown, and that of the under part was brighter.

I received from Canada the head of a female orignal which was more advanced in years. Its length, from the end of the muzzle to the ears, is two feet three inches. Its circumference at the ears is two feet eight inches, and near the mouth one foot ten inches. The ears are nine inches long. But, as this head is dried, these dimensions must be smaller than when the animal was alive.

M. de Buffon is likewise of opinion, that the caribou of America is the rain deer of Lapland; and the reasons with which he supports this idea have much weight. I have given a figure of the rain deer, which is wanting in the Paris edition. It is a copy of that which was published by Ridinger, a famous painter and engraver, who drew it from the life. I have likewise been obliged to the Duke of Richmond for a drawing of the American caribou. This animal was sent to him from Canada, and it lived a long time in his park. His horns were only beginning to shoot when the figure was drawn; and it is the only true representation we have of the animal. By comparing it with the rain deer, there appears at first sight to be a very considerable difference between the two figures; but the want of horns in the caribou greatly changes its aspect.

Addition by the Count de Buffon.

I here give an engraving of a rain deer, drawn from a living female in the possession of the Prince of Condé.

It was sent to him by the King of Sweden, along with two males, one of which died on the road, and the other lived only a short time after its arrival in France. The female resisted the effects of the climate for a considerable time. She was of the size of a hind; but her legs were shorter, and her body thicker. Her horns, like those of the male, were divided into antlers, some of which pointed forward, and others backward. But they were shorter than those of the males. The following description of this animal was communicated to me by M. de Seve.

'The length of the whole body, from the muzzle to 'the anus, in a superficial line, is five feet one inch. 'The height of the withers is two feet eleven inches, 'and that of the crupper two feet eleven inches nine 'lines. The hair is thick and close, like that of the 'stag, the shortest on the body being an inch and three 'lines in length. It is longer on the belly, very short 'on the limbs, and very long about the fetlock. The 'colour of the hair which covers the body is a reddish 'brown, more or less deep in different parts, and 'sprinkled with a kind of yellowish white. Upon part 'of the back, the thighs, the top of the head, and chan-'frin, the hair is deeper coloured, especially above the 'eye-pits, which the rain deer has as well as the stag. 'The circumference of the eye is black. The muzzle is 'a deep brown, and the circumference of the nostrils is 'black. The point of the muzzle, as far as the nostrils, 'as well as the end of the under jaw, are of a bright 'white colour. The ear is covered above with thick 'white hair, approaching to yellow, and mixed with 'brown. The inside of the ear is adorned with large 'white hairs. The neck and upper part of the body, as 'well as the large hairs which hang on the breast below 'the neck, are of a yellowish white colour. Upon the 'sides, above the belly, there is a large band, as in the 'gazelle. The limbs are slender in proportion to the 'body; and they, as well as the thighs, are of a deep 'brown, and of a dirty white colour on the inside. The 'ends of the hairs which cover the hoofs are likewise of 'a dirty white. The feet are cloven, like those of the 'stag. The two fore-toes are broad and thin: the 'small ones behind are long, pretty thin, and flat on the 'inside. They are all extremely black.'

By the figure I have given, no judgment must be formed of the length and thickness of the rain deer's horns, some of which extend backward from the head as far as the crupper, and project forward in antlers of more than a foot long. The large fossil horns found in different places, and particularly in Ireland, appear to have belonged to the rain deer species. Mr. Collinson informed me that he had seen some of these fossil horns with an interval of ten feet between their extremities, and with brow antlers, like those of the rain deer.

It is to this species, therefore, and not to that of the elk, that the fossil bones of the animal called *mouse-deer* by the British are to be referred. We must acknowledge, however, that no rain deer now exist of such magnitude and strength as to carry horns so long and massy as those found in a fossil state in Ireland, as well as in several other parts of Europe, and even in North America.

Besides, I knew only one species of rain deer, to which I referred the caribou of America, and the Greenland fallow deer, described and engraven by Mr. Edwards: and it is not long since I was informed, that there were two species, or rather two varieties, the one much larger than the other. The rain deer, of which I have given a figure, is the small kind, and probably the same with the Greenland fallow deer of Mr. Edwards.

Some travellers tell us, that the rain deer is the fallow deer of the North; that, in Greenland, it is wild; and that the largest of them exceed not the size of a two year old heifer.

Pontoppidan assures us, that the rain deer perish in every part of the world, except the northern regions, where they are even obliged to inhabit the mountains. He is less to be credited when he tells us, that their horns are moveable; that the animal can turn them either forward or backward; and that, above the eyelids, there is a small aperture in the skin, through which he sees, when the snow prevents him from opening his eyes. This last fact appears to be imaginary, and borrowed from a practice of the Laplanders, who cover their eyes with a piece of split wood, to avoid the great splendour of the snow, which renders them blind in a few years, if this precaution is neglected.

It is remarkable, that these animals, in all their movements, make a crackling noise. Independent of running, even when surprised or touched, this noise is heard. I have been assured that the same thing happens to the elk; but I cannot ascertain the truth of this assertion.

Observations on the rain deer, by Profsssor Camper of Groningen.

The rain deer sent to me from Lapland by the way of Drontheim and Amsterdam, arrived at Groningen the 21st day of June, 1771. It was very feeble, not only on account of the heat of the climate and the fatigue of the voyage, but chiefly from an ulcer between the second stomach and the diaphragm, of which it died the next day. While it lived, it eat, with appetite, grass, bread, and other things presented to it, and likewise drank very copiously. It did not die for want of nourishment; for, upon dissection, I found all its stomachs full. Its death was slow, and accompanied with convulsions.

It was a male of four years old. In all the bones of the skeleton, there were epiphyses, which proves that it had not yet acquired its full growth, which happens not

till five years of age. Hence this animal may live at least twenty years.

The colour of the body was brown, mixed with black, yellow, and white. The hairs on the belly, and particularly on the flanks, were white, and brown at the points, as in other deer. The hair on the limbs was a deep yellow; and that on the head inclined to black. The hair on the flanks, as well as on the neck and breast, was long and bushy.

The hair which covered the body was so brittle, that, when slightly pulled, it broke transversely. It lay in an undulated form, and its substance resembled the pith of rushes. The brittle part of it was white. The hair on the head and the under part of the legs, as far as the hoofs, had not this fragility, but, on the contrary, was as strong as that of a cow.

The coronet of the hoofs was covered on all sides with very long hair. Between the toes of the hind feet there was a broad pellicle, composed of the skin which covers the body, but interspersed with small glands.

In the hind feet, at the height of the coronets, a kind of canal, sufficient to admit a goose quill, and filled with very long hairs, penetrated as far as the articulation of the canon with the small bones of the toes. I discovered no such canal in the fore feet; neither do I know the use of it.

The figure of this animal differed much from that described by other authors, because it was extremely emaciated. The length of the body, from the muzzle to the anus, was five feet, and its height before three feet.

The eyes differ not from those of the fallow deer or stag. The pupil is transverse; and the iris is brown, inclining to black. The eye-pits resemble those of the stag, and are filled with a whitish, resinous, and somewhat transparent matter. As in the fallow deer, there are two lachrymal ducts and canals. The upper eye-lid has very long, black *cilia*. It is not perforated, as some authors have fancied, but entire. The Bishop of Pontoppidan, and, upon his authority, Mr. Haller, have attempted to account for this supposed perforation: They thought it necessary, in a country perpetually covered with snow, to defend the animal's eyes against the excessive glare of reflected light. Man, who is destined to live in all climates, prevents blindness as much as possible by veils, or small perforated machines, which weaken the splendour of the light. The rain deer, who is made for this climate alone, has no occasion for such mechanism. But he is furnished with a nictitating membrane, or an internal eye-lid, like the birds, and some other quadrupeds. Neither is this membrane perforated: It is capable of covering the whole cornea.

The nose of the rain deer is very large, like that of the cow; and the muzzle is more or less flat, and covered with long grayish hair, which extends to the internal part of the nostril. The lips are likewise covered with hair, except a small border, which is blackish, hard, and very porous. The nostrils are very distant from each other. The under lip is narrow, and the mouth deep cut, as in the sheep.

He has eight cutting teeth in the under jaw; but they are very small, and loosely fixed. Like the other ruminating animals, he has no cutting teeth in the upper jaw. But I thought I perceived tusks, though they had not yet pierced the gums; and I observed no such appearance in the under jaw. Horses have tusks in both jaws; but mares seldom have any. The fallow deer, both males and females, seldom or never have tusks. But I lately procured the head of a hind recently brought forth, which had a large tusk in the left side of the upper jaw: Nature is so various in this article, that no constant rule can be established. There are six grinders in each side of both jaws, or twenty-four in all.

I have nothing to remark concerning the horns; for they were only beginning to shoot: One of them was an inch, and the other an inch and a half high. Their base was situated nearer the occiput than the orbit of the eye. The hair which covered them was beautifully turned, and of a gray colour, inclining to black. In viewing the two shoots at a distance, they had the appearance of two large mice sitting on the animal's head.

The neck is short, and more arched than that of the sheep, but less than that of the camel. The body seemed to be naturally robust. The back is a little elevated toward the shoulders, and pretty straight every where else, though the vertebræ are somewhat arched.

The tail is very small, bent downward, and garnished with long bushy hair.

The testicles are very small, and appear not without the body. The penis is not large. The prepuce is naked, like a navel, full of wrinkles in the inside, and covered with a calcareous crust.

The hoofs are large, long, and convex on the outside. The spurs are also very long, and some of them touch the ground when the animal stands. They were hollow, probably because he makes no use of them.

The intestines were exactly similar to those of the fallow deer. There was no gall-bladder. The kidneys were smooth, and undivided. The lungs and wind-pipe were very large.

The heart was of a middle size, and, like that of the fallow deer, contained one small bone only. This bone supported the base of the semilunar valve of the aorta, which is opposed to two others, from which the coronary arteries of the heart derive their origin. It likewise gives firmness to the membranous partition between the two cavities of the heart, and to the triglochine valve of the right ventricle.

In this animal there is a singular pouch, very large, membranous, and situated under the skin of the neck,

It begins by a conical canal between the os hyoides and the thyroide cartilage. This canal gradually enlarges, and is changed into a kind of membranous sac, supported by two oblong muscles, which derive their origin from the inferior part of the os hyoides, precisely where the base, the pisiform bone, and the cornua unite.

This pouch opens into the larynx, under the root of the epiglottis, by a large orifice, which easily admitted my finger.

When the animal pushed the air forcibly out of the lungs, as in lowing, the air passed into this pouch, swelled it, and necessarily produced a considerable tumour, which greatly changed the sound. The two muscles drive the air out of the pouch when the animal ceases its lowing.

About twenty years ago I showed a similar pouch in several baboons and monkeys; and the year following I demonstrated to my pupils that there was a double pouch in the ourang-outang.

THE WILD GOAT, THE CHAMOIS GOAT, AND OTHER GOATS.

THE wild goat has large knotted horns, reclining backward, and a very small head. On the chin of the male there is a dusky beard; the rest of the hair is tawny, mixed with ash colour. The females are less, and have smaller horns, more like those of the common she-goat, and have few knobs on the upper surface. They bring one young, seldom two, at a time.

The chamois goat has slender, black, upright horns, hooked at the end. Behind each ear there is a large orifice in the skin. The forehead is white, and along the cheeks there is a dusky bar. The rest of the body is of a deep brown colour. The tail is short; the hoofs are long and much divided.

The Greeks, it is probable, were acquainted with the wild and chamois goats. But they have neither pointed out these animals by particular denominations, nor by characters so precise as to enable us to distingush them. They have denominated them in general, *wild goats*. They perhaps regarded these animals as of the same species with the domestic kind, having never bestowed on them proper names, as they have done to every other species of quadruped. Our modern naturalists, on the contrary, have considered the wild and chamois goat as two distinct species, and both different from the common goat. There are facts and arguments in favour of both opinions, of which we shall only give a detail, till we learn from experience whether these animals can intermix and produce fertile individuals; as this circumstance alone can determine the question.

The male wild goat differs from the chamois in the length, thickness, and figure of his horns. His body is also larger, and he is more vigorous and strong. The horns of the female wild goat are smaller than those of the male, and have a great resemblance to those of the chamois. Besides, the manners and dispositions of these two animals are the same, and they inhabit the same climate; only the wild goat, being stronger and more agile, goes to the summits of the highest mountains, while the chamois never rises higher than the second stage. But neither of them are found in the plains. Both of them clear roads in the snow, and leap from one precipice to another. Both are covered with a firm, solid skin, and clothed in winter with a double fur, the external hair being coarse, and the internal finer and more bushy. Both of them have a black band on the back, and tails of nearly an equal size. The number of external resemblances is so great, and the conformity of the internal parts is so complete, that we should be induced to conclude, that these two animals are not only simple but permanent varieties of the same species. Besides, the wild, as well as the chamois goats, when taken young, and reared along with the domestic kind, are easily tamed, assume the same manners, go in flocks, return to the same fold, and probably couple and produce together. I acknowledge, however, that this last fact, which is the most important of all, and would alone decide the question, is by no means established. We have never been able with certainty to learn whether the wild and chamois goats produce with the common kind. We only suspect this to be the case. In this respect we agree with the ancients; and besides our conjecture seems to be founded on strong analogies, which are seldom contradicted by experience.

[The inhabitants of the island of Crete might take the young of the bouc-estain (of which there are great numbers) wandering in the mountains, and feed and tame them along with the domestic kind. They are covered with yellow hair. When old they become gray, and a black line runs along the spine of the back. We have some of them in the mountains of France, and chiefly in places full of precipices, and of difficult access. The bouc-estain leaps from one rock to another at the

distance of six fathoms—an exertion almost incredible to those who have not seen it.—*Belon.*

In the compilation of natural history made by Mess. Arnault de Nobleville and Salerne, it is said, that the chamois goats are in season during almost the whole month of September; that the female goes with young nine months; and that they generally bring forth in June. If these facts were true, they would demonstrate that the chamois is not the same species with the goat, which goes with young about six months only: but I think they are suspicious, if not false. The hunters, as appears from the passages already quoted, assure us, on the contrary, that the chamois and wild goats do not come in season till the month of November; and that the females bring forth in May. Thus the time of gestation, instead of being extended to nine months, should be reduced to near five, as in the domestic goat. But this matter must be decided by experience alone.]

Let us, however, consider the opposite arguments. The wild and chamois goats both subsist in the state of nature, and yet they always remain distinct. The chamois sometimes mingles spontaneously with the flocks of the domestic kind; but the wild goat never associates with them unless when tamed. The male wild goat and the common he-goat have very long beards, and the chamois has none. The horns of the male and female chamois are small: those of the wild he-goat are so large and so long, that we could hardly imagine they belonged to an animal of his size. The chamois seems to differ from the wild goat and the common he-goat by the direction of his horns, which incline a little forward in their inferior part, and bend backward at the point like a hook. But as we remarked in the history of the ox and sheep, the horns of domestic animals, as well as those of wild animals living in different climates, vary prodigiously. The horns of our female goat are not entirely similar to those of our male. The horns of the male wild goat are not very different from those of our he-goat: and as the female wild goat approaches the domestic kind, and even the chamois, in size, and in the smallness of its horns, may we not conclude, that the males of the wild, chamois, and domestic goats, are only one species of animal, in which the nature of the females is constant and similar among themselves, but that the males are subject to considerable variations? In this point of view, which is not perhaps removed so far from nature as may be imagined, the wild goat would be the original male stock, and the chamois would be the female. I say, that this point of view is not imaginary, since we can prove from experience, that there are animals in nature in which the female can equally serve males of different species, and produce from them both. The sheep produces with the he-goat as well as with the ram, and always brings forth lambs which are individuals of its own species. The ram, on the contrary, produces not with the she-goat. The sheep, therefore, may be regarded as a female common to two different males; and, consequently, she constitutes a species independent of the male. The same thing will happen to the wild goat. The female alone represents the primitive species, because her nature is constant. The males, on the contrary, vary; and it is extremely probable, that the domestic she-goat, which may be considered as the same female as those of the wild and chamois kinds, would produce equally with these three different males, which alone admit of varieties in species; and, consequently, though they seem to change the unity, alter not the identity of the species.

[The want of a beard in the chamois is a female character, which ought to be added to the others. The male chamois appears, as well as the female, to participate of the feminine qualities of the she-goat. Thus it may be presumed, that the domestic he-goat would engender with the female chamois; and that, on the contrary, the male chamois could not engender with the female domestic goat. Time will verify or destroy this conjecture.]

These, as well as all other possible relations, must necessarily exist in nature. It even appears that the females contribute more to the support of the species than the males; for though both concur in the first formation of the fœtus, the female, who afterwards furnishes every thing necessary to its growth and nutrition, modifies and assimilates it more to her own nature, and must, therefore, greatly efface the impression of the parts derived from the male. Thus, if we want to form a distinct judgment of a species, we ought to examine the females. The male bestows one half of the animated substance: the female gives an equal portion, and furnishes, besides, all the matter necessary for the developement of the form. A beautiful woman seldom fails to produce beautiful children. The offspring of a beautiful man with an ugly woman are generally still more ugly.

Hence, even in the same species, there may sometimes be two races, the one masculine and the other feminine, which, by both subsisting and perpetuating their distinctive characters, appear to constitute two different species; and this seems to be the case, when it is almost impossible to fix the limits between what naturalists term *species* and *variety*. Let us suppose, for example, that some sheep were always served with he-goats, and others with rams; after a certain number of generations, a race would be established among the species of sheep, which would partake greatly of the nature of the goat, and would afterwards perpetuate its own kind; for though the first produce of the he-goat would be little removed from the mother's species, and would be a lamb, and not a kid; yet this lamb is already covered with hair, and possesses some other characters of

the father. Let these female mongrels be afterwards served with a he-goat; the produce in this second generation will make a nearer approach to the species of the father, and still nearer in the third, &c. In this manner, the foreign characters would soon overbalance the natural ones; and this fictitious race might support itself, and form a variety in the species, the origin of which it would be difficult to trace. Now, what might arise from the influence of one species on another, may be produced with greater ease in the same species. If vigorous females be constantly served with feeble males, in process of time, a feminine race will be established; and, if very strong males are appropriated to females of inferior strength and vigour, a masculine race will be the result, so different in appearance from the first, that we could not assign to them a common origin, and, of course, would regard them as two distinct species.

To these general reflections, we shall add some particular facts. We are assured by Linnæus, that he saw in Holland two animals of the goat-kind, of which the one had very short, thick horns, lying almost flat on the skull; the horns of the other were erect, and bended backward at the points, and its hair was short. These animals, though they seemed to be more remote in species than the chamois and common goat, failed not to produce together; which demonstrates that these differences in the figure of the horns, and length of the hair, are not essential and specific characters; for, as the animals produced together, they must be regarded as belonging to the same species. From this example, it may be concluded, that the chamois and our goat, whose principal differences lie in the form of the horns and the length of the hair, are probably the same species.

In the royal cabinet, there is the skeleton of an animal, which was sent under the name of *capricorne*. In the form of the body and proportions of the bones, it has a perfect resemblance to the domestic he-goat; and the figure of the under jaw is the same with that of the wild goat. But it differs from both in the horns: Those of the wild goat have prominent tubercles or knobs, and two longitudinal ridges, between which there is a well-marked anterior face: those of the common he-goat have but one ridge, and no tubercles. The horns of the capricorne have but one ridge, and no anterior face: though they want tubercles, they have rugosities which are larger than those of the he-goat. These differences seem to indicate an intermediate race between the wild and the domestic goat. Besides, the horns of the capricorne are short, and crooked at the point, like those of the chamois; and, at the same time, they are compressed and have rings: hence they partake at once of the he-goat, the wild goat, and the chamois goat.

Mr. Brown, in his history of Jamaica, informs us, that there are in that island, 1. The common domestic goat of Europe; 2. the chamois; 3. the wild goat. He assures us, that none of these animals are natives of America, but have been transported from Europe; that, like the sheep, they have degenerated and become smaller in this new country; that the wool of the sheep is changed into hair as coarse as that of the goat; that the wild goat seems to be a bastard race, &c. Hence we are led to believe, that the small goat with erect horns, and crooked at the points, which Linnæus saw in Holland, and was said to have come from America, is the chamois of Jamaica, that is, the European chamois degenerated and diminished by the climate of America; and that the wild goat of Jamaica, called the *bastard wild goat* by Mr. Brown, is our capricorne, which seems to be nothing else than the wild goat degenerated by the influence of climate.

M. Daubenton, after scrupulously examining the relations of the chamois to the he-goat and ram, says, in general, that it has a greater resemblance to the he-goat than to the ram. Next to the horns, the chief differences are found in the figure and size of the front, which is less elevated and shorter, and the form of the nose, which is more contracted in the chamois than in the he-goat; so that, in these two articles, the chamois resembles the ram more than the he-goat. But, by supposing what is extremely probable, that the chamois is a constant variety of the species of the he-goat, as the bull-dog and greyhound are constant varieties in the dog-kind, we will perceive that these differences in the size of the front and the position of the nose, are not nearly so great in the chamois, when compared with the he-goat, as in the bull-dog and greyhound, which, however, produce together, and certainly belong to the same species. Besides, as the chamois resembles the he-goat in a greater number of characters than the ram, if he constituted a particular species, it must necessarily be an intermediate one between the he-goat and the ram. Now, we have seen, that the he-goat and ewe produce together: the chamois, therefore, which is an intermediate species between the two, and, at the same time, has a greater number of resemblances to the he-goat than to the ram, ought to produce with the she-goat, and, consequently, should be regarded as only a constant variety of this species.

Hence, as the chamois was transported into America, where it has become smaller, and produces with the small she-goat of Africa, it is more than probable that he would also produce with our she-goats. The chamois, therefore, is only a constant variety in the goat-kind, like the bull-dog in the species of dog. On the other hand, the wild goat is unquestionably the primitive goat in a state of nature, and is, with regard to the domestic goats, what the mouflon is to the sheep. The wild he-goat perfectly resembles the domestic he-goat in figure, structure, habits, and dispositions; and there are only two slight external differences between

them. The horns of the wild he-goat are larger than those of the common he-goat. The former have two longitudinal ridges, and the latter but one. They have also large transverse protuberant rings, which mark the years of their growth; whilst those of the domestic he-goat have only a kind of transverse striæ or furrows. The figure of their bodies is precisely the same. Their internal structure is likewise perfectly similar, with the exception of the spleen, which is oval in the wild he-goat, and approaches nearer to the spleen of the roebuck or stag, than to that of the he-goat or ram. This difference may proceed from the violent exercise of the animal. The wild he-goat runs as swiftly as the stag, and leaps more nimbly than the roebuck. His spleen, therefore, should resemble that of the swiftest running animals. Hence this slight difference depends more upon habit than nature; and it is probable, that, if our domestic he-goat should become wild, and were obliged to run and leap like the wild he-goat, his spleen would soon assume the figure most conformable to this exercise. With regard to the difference of his horns, though very conspicuous, they fail not to resemble those of the domestic he-goat more than those of any other animal. Thus the wild and common he-goat approach nearer each other, even in the form of their horns, than any other animal; and, as their resemblance is complete in every other article, we should conclude, that, notwithstanding this slight and solitary difference, they are both animals of the same species.

The wild, the chamois, and the domestic goat must, therefore, be considered as the same species, the males of which have undergone greater variations than the females: I find, at the same time, in the domestic kind, secondary varieties, which are the less equivocal, because they belong equally to the males and females. We have seen that the goat of Angora, though very different from ours in the hairs and horns, is nevertheless of the same species. The same thing may be said of the Juda goat, which Linnæus has properly considered as a variety of the domestic species. This goat, which is common in Guinea, Angola, and other parts of Africa, may be said to differ from ours only in being smaller, fatter, and more squat. Its flesh is excellent; and, in that country it is preferred to mutton, as we prefer mutton to goat's flesh. The Levant or Mambrina goat, with long pendulous ears, is only a variety of the goat of Angora, which has also pendulous ears, though they are not so long. These two goats were known to the ancients; but they did not separate them from the common species. This variety of the Mambrina or the Syrian goat is more diffused than the goat of Angora; for we find goats with long ears in Egypt, and in the East Indies, as well as in Syria. They yield a great deal of fine milk, which the natives of the east prefer to that of the cow or buffalo.

With regard to the small goat which Linnæus saw alive, and which produced with the American chamois, it must, as formerly remarked, have been originally transported from Africa; for it so strongly resembles the he-goat of Africa; that it is unquestionably the same species; or, at least, it has sprung from the same stock. In Africa it is small; and it would become still less in America; and we learn, from the testimony of travellers, that sheep, hogs, and goats, have frequently and for several ages back, been transported from Africa, as well as Europe, into America, where they still subsist, without any other change than a diminution of size.

After examining the different varieties of goats, of which the nomenclators have made nine or ten different species, I am convinced that they ought to be reduced to one: 1. The wild he-goat is the principal stock of the species. 2. The capricorne is the wild he-goat degenerated by the influence of climate. 3. The domestic he-goat derives its origin from the wild he-goat. 4. The chamois is only a variety in the species of the she-goat, with whom, like the wild he-goat, he should be able to mix and produce. 5. The small goat, with erect horns, crooked at the points, mentioned by Linnæus, is the European chamois diminished by the influence of the American climate. 6. The other small goat, with horns lying flat on the skull, and which produced with the American chamois, is the same with the African he-goat; the fertility of these two animals is a proof that our chamois, and domestic goat would also produce together, and, of course, that they belong to the same species. 7. The dwarf goat, which is probably the female of the African buck, is only, as well as the male, a variety of the common kind. 8. The same thing may be said of the buck and she-goat of Juda; for they are only varieties of our domestic goat. 9. The goat of Angora, as it produces with our goats, belongs to the same species. 10. The Mambrina or Syrian goat, with very long pendulous ears, is a variety of the goat of Angora. Thus these ten animals are only different races of the same species, which have been produced by the influence of climate. Indeed, from this enumeration, it is apparent, that the goats, though essentially similar among themselves, vary greatly in their external form; and, if we comprehend, like Pliny, under the generic name of *Goats*, not only those we have mentioned, but likewise the roebuck, the antilopes, &c. this species would be the most extensive in Nature, and contain more races and varieties than that of the dog. But Pliny, when he joined the roebuck, antilopes, &c. to the species of the goat, betrayed his ignorance of the real distinction of species. These animals, though they resemble the goat in many respects, constitute two different species; and we will perceive from the following articles, how greatly the antilopes vary both in species and in races; and, after enumerating all

the antilopes and all the goats, we will still find other animals which participate of both. In the whole history of quadrupeds, I have met with nothing so confused, so uncertain, and so obscure, as the accounts given us by naturalists and travellers concerning the goats, the antilopes, and the species which have a relation to them. I have exerted every effort to throw light upon this subject; and shall not regret my labour, if what I now write should contribute to remove error, and to extend the views of those who incline to study nature. But to return to our subject.

The goats are subject to vertigos: this disease is likewise common to the wild and chamois goats, as well as the inclination to climb upon rocks, and the habit of perpetually licking stones, especially those which are impregnated with nitre or salt. In the Alps we find rocks hollowed with the tongues of the chamois. They are generally composed of tender and calcinable stones, in which there is always a certain quantity of nitre.

[What is singular, in the Alps there are several rocks which have been hollowed by the constant licking of the chamois goats. This licking is not occasioned, as has been alledged, by salt contained in these stones, which is very rarely the case; for the rocks are porous, and composed of grains of sand, which are easily detached; and they are swallowed by the animals with great avidity.—*Scheuchzer.*]

These conformities in natural dispositions and manners appear to be infallible indications of identity of species. The Greeks, as formerly remarked, did not divide these three animals into three distinct kinds; and our hunters, who probably never consulted the Greeks, have also regarded them as the same species. Gaston Phœbus, when treating of the wild goat, points him out under the name of the *wild buck;* and the chamois, which he calls *ysarus* and *sarris*, in his estimation, is only another wild buck. I acknowledge, that all these authorities amount not to a complete proof: but when joined to the facts and reasonings already employed, they form so strong a presumption, with regard to the unity of species in these three animals, as leaves no room for hesitation.

The wild and chamois goats, which I considered, the one as the male, and the other as the female stock of the goat kind, are only found, like the mouflon, which is the stock of the sheep, in the deserts and in the highest and most rugged mountains. The Alps, the Pyrenees, the Grecian mountains, and those in the islands of the Archipelago, are almost the only places where the wild and chamois goats are to be found. Though both avoid heat, and inhabit the regions of snow and frost, yet they equally avoid the excessive rigours of cold. In summer they dwell on the northern sides of the mountains; in winter they frequent the southern sides, and descend from the summits into the plains. Neither of them can support themselves on smooth sheets of ice; but when the ice is rendered rough by the snow, they run and bound with great firmness and agility. The chase of those animals, especially that of the wild he-goat, is very laborious; for dogs are almost useless in this kind of hunting. It is also sometimes dangerous: when the animal finds himself hard pushed, he gives the hunter a violent blow with his head, and often throws him over a precipice.

[There are two kinds of buck; some are called *wild bucks*, and others *ysarus* or *sarris*. The wild bucks are as large as a stag; but though they have as much flesh, they are neither so long, nor make such great bounds. The years of their age correspond with the number of rings which encircle their horns. When old their horns, which have no branches, are as thick as a man's leg. They never cast their horns: but they continue to grow in length and thickness as long as the animal lives. They have a large beard, and their hair is brown like that of the wolf. A black bar runs along their back and down the buttocks. Their belly is yellow, and their legs black, and yellow behind. Their feet, like those of the domestic goat, are cloven; and their tracks are large, and rounder than those of the stag. The female, like that of the hind, or common she-goat, produces but one at a time.

The bucks feed upon herbage like other cattle. Their dung resembles that of the domestic goat. They come in season about All-Saints-day, and their rutting season continues a month. When that season is over, they are much emaciated; and they descend from the rocks and mountains, where they had dwelt during the summer, to the plains, in quest of food. They remain at the foot of the mountains till toward Easter, when they return to the most elevated places they can find, and each takes possession of his bush, like the stags. The females, at this period, separate from the males, and retire near the brooks, in order to fawn, where they remain during the summer. When the bucks are thus separated from the females, especially at the approach of the rutting season, they attack both man and beast. They also fight among themselves, like the stags, but in a different manner; for their quarrels are more formidable. The buck strikes so furiously with his head, that he often breaks the legs of those whom he attacks; and if he runs a man against a tree, or throws him down on the ground, death is infallibly the consequence. Such is the nature of the buck, that though a strong man gives him a blow on the back with a bar of iron, the animal's spine does not break. In the season of love his neck swells prodigiously: and though he falls from a height of ten fathoms he receives no injury.

The buck called *ysarus* is of the same figure with the preceding, and is not larger than the domestic he-goat. His nature is the same with that of the wild buck. Like

the stag both come in season about All-Saints-day, and they should be hunted till that period arrives. When they can find no other food in winter, they eat the leaves of the pine-tree, which are always green. Their skin, when properly dressed, is an excellent defence against the cold; for when the hair is outmost neither cold nor rain can penetrate it. Their flesh is not very wholesome; for it produces fevers. The hunting of the buck is not very pleasant; for we can neither accompany the dogs on foot nor on horseback.—*Dufouilloux.*]

Though not so strong as the wild bucks, the chamois goats are equally active. They are more numerous, and go generally in flocks. In the Alps and Pyrenees, however, they are not now so frequent as formerly. The term *chamoiseurs*, which was applied to all transporters of skins, seems to indicate, that the chamois skins were at that time the chief article of their commerce; but the skins of goats, sheep, stags, roebucks, and the fallow deer, are their principal objects.

[M. Perroud, undertaker of the chrystal mines in the Alps, brought a live chamois to Versailles, and gave us the following excellent remarks on the nature and manners of this animal. 'The chamois, though a wild animal, is very docile. He inhabits only the mountains and rocks. He is of the size of a domestic goat, which he greatly resembles. His vivacity is delightful, and his agility truly admirable. His hair is as short as that of a hind: in spring it is ash-coloured, in summer it is yellowish, in autumn yellowish brown mixed with black, and in winter brownish black. The chamois goats are numerous in the mountains of Upper Dauphiny, Piedmont, Savoy, Switzerland, and Germany. They are very social among themselves: we find them going in pairs, or in little flocks of from three to twenty; and sometimes we see from sixty to a hundred of them dispersed in different flocks along the declivity of the same mountain. The large males keep at a distance from the rest, except in the rutting season, when they join the females, and beat off all the young. At this period their ardour is still stronger than that of the wild bucks. They bleat often, and run from one mountain to another. Their season of love is in the months of October and November, and they bring forth in March and April. A young female takes the male at the age of eighteen months. The females bring forth one, but rarely two, at a time. The young follow their mothers till October, if not dispersed by the hunters or the wolves. We are assured that they live between twenty and thirty years. Their flesh is very good. A fat chamois goat will yield from ten to twelve pounds of suet, which is harder and better than that of the goat. The blood of the chamois is extremely hot, and it is said to have qualities and virtues nearly equal to those of the wild goat, and may serve the same purposes; for the effects are the same when taken in a double dose. It is good against pleurisies, and possesses the property of purifying the blood, and promoting perspiration. The hunters sometimes mix the blood of the wild and chamois goats: at other times they sell the blood of the wild goat for that of the chamois. It is very difficult to distinguish them; which shows that the blood of the wild goat differs very little from that of the chamois. The voice of the chamois is a very low and almost imperceptible kind of bleating, resembling that of a hoarse domestic goat. It is by this bleating that they collect together, particularly the mothers and their young. But when alarmed, or when they perceive an enemy, or any thing the nature of which they cannot distinguish, they advertise one another by a kind of whistling noise, which I shall afterwards describe. The sight of the chamois is very penetrating, and his sense of smelling is acute. When he sees a man distinctly, he stops for some time, and flies off when he makes a nearer approach. His sense of hearing is equally acute as that of smelling; for he hears the smallest noise. When the wind blows in the direction between him and a man he will perceive the scent at the distance of more than half a league. Hence, when he smells or hears any thing which he cannot see, he whistles or blows with such force that the rocks and forests re-echo the sound. If there are many of them near they all take the alarm. This whistling is as long as the animal can blow without taking breath. It is at first sharp, and turns flat towards the end. The chamois then stops for a moment, looks round on all sides, and begins whistling afresh, which he continues from time to time. His agitation is extreme. He strikes the earth with his feet. He leaps upon the highest stones he can find: he again looks round, leaps from one place to another, and when he discovers any thing, he flies off. The whistling of the male is sharper than that of the female. This whistling is performed through the nostrils, and consists of a strong blowing, similar to the sound which a man may make by fixing his tongue to the palate, with his teeth nearly shut, his lips open, and somewhat extended, and blowing long and with great force. The chamois feeds on the finest herbs. He selects the most delicate parts of plants, as the flowers and the tenderest buds. He is very fond of some aromatic herbs, particularly of the carline thistle and genipay, which are the hottest plants that grow in the Alps. When he eats green herbs he drinks very little. He is very fond of the leaves and tender buds of shrubs. He ruminates like the common goat. The food he uses seems to announce the heat of his constitution. This animal is admired for his large round eyes, whose size corresponds with the vivacity of his disposition. His head is adorned with two small horns, from half a foot to nine inches in length. Their colour is a fine black, and they are placed on the front nearly between his eyes; and, instead of being reflected backward, like those of other animals, they advance

forward above the eyes, and bend backward at the points, which are extremely sharp. He adjusts his ears most beautifully to the points of his horns. Two tufts of black hair descend from the horns to the sides of his face. The rest of the head is of a yellowish white colour, which never changes. The horns of the chamois are used for the heads of canes. Those of the female are smaller and less crooked. The skin of the chamois, when dressed, is very strong, nervous, and supple, and makes excellent riding breeches, gloves, and vests. Garments of this kind last long, and are of great use to manufacturers. The chamois is a native of cold countries, and always prefers rugged rocks and lofty places. They frequent the woods; but it is only those in the higher regions of the mountains. These woods consist of pines, larches, and beeches. The chamois goats are so impatient of heat, that in summer they are only to be found under the shades of caverns in the rocks, among masses of congealed snow and ice, or in elevated forests on the northern declivities of the most scabrous mountains, where the rays of the sun seldom penetrate. They pasture in the mornings and evenings, and seldom during the day. They traverse the rocks and precipices with great facility, where the dogs dare not follow them. There is nothing more worthy of admiration than to see these animals climbing or descending inaccessible rocks. They neither mount nor descend perpendicularly but in an oblique line. When descending, particularly, they throw themselves down across a rock, which is nearly perpendicular, and of twenty or thirty feet in height, without having a single prop to support their feet. In descending they strike their feet three or four times against the rock, till they arrive at a proper resting place below. The spring of their tendons is so great, that when leaping about among the precipices, one would imagine they had wings instead of limbs. It has been alledged, that the chamois, in climbing and descending rocks, supports himself by his horns. I have seen and killed many of these animals; but I never saw them use their horns for this purpose; neither did I ever hear the fact supported by any hunter. It is by the strength and agility of his limbs that the chamois is enabled to climb and to descend rocks. His legs are very free and tall; those behind are somewhat longer, and always crooked, which favours their springing to a great distance; and when they throw themselves from a height, the hind legs receive the shock, and perform the office of two springs in breaking the fall. It is said, that when there are numbers of chamois goats together, one is deputed to stand sentinel, for the protection of the rest. I have seen many flocks of them, but never observed this part of their œconomy. It is true, that when there are many of them some always watch while others eat; but I remarked nothing more singular here than what happens in a flock of sheep: for the first who perceives any thing alarming advertises the rest, and in an instant the same terror is communicated to the whole. In great snows, and during the rigour of winter, the chamois goats inhabit the lower forests, and live upon pine leaves, the buds of trees, bushes, and such green or dry herbs as they can find by scratching off the snow with their feet. The forests that delight them most are those which are full of rocks and precipices. The hunting of the chamois is very difficult and laborious. The mode most in use is to kill them by surprise. The hunters conceal themselves behind rocks or large stones, taking care that the wind blows opposite to them, and when a favourable opportunity occurs, shoot them with musket balls. They are likewise hunted in the same manner as stags and other animals, by posting some of the hunters in narrow passages, while others beat about to raise the game. Men are preferable for this purpose to dogs; for dogs too quickly disperse the animals, who fly off suddenly to the distance of four or five leagues.' See also on this subject, *La troisieme Descript. du Voyage des Alpes de Scheuchzer.*]

With regard to the specific virtue attributed to the blood of the wild goat, against certain diseases, and particularly the pleurisy, a virtue which is thought to be peculiar to this animal, and which, of course, would lead us to think it to be of a peculiar nature; it has been discovered that the blood of the chamois, and likewise that of the domestic he-goat, have the same properties when the animals are nourished with the same aromatic herbs; so that even this property seems to unite these three animals in the same species.

SUPPLEMENT.

We formerly mentioned Syrian goats with pendulous ears, which were nearly of the same size with the domestic kind, and produced with them even in our climate. In Madagascar there is a goat considerably larger, with pendulous ears so long, that when they fall down they cover the eyes, which obliges the animal to move its head almost continually in throwing them back. Hence, when pursued, it always endeavours to ascend. This notice was communicated to us by M. Comerson; but it is too imperfect to enable us to determine whether this goat belongs to the Syrian race with pendulous ears, or to a different species.

We had the following note from M. le Vicomte de Querhoent.

'The goats which were left on Ascension island have 'multiplied greatly; but they are very meagre, espe-'cially in the dry season. The whole island is beaten 'with their tracks. During the night they retire into 'the excavations of the mountains. They are not so 'large as the common goat. They are so weak, that 'men sometimes seize them in the chace. Their hair is 'generally of a deep brown colour.'

THE SAIGA, OR SCYTHIAN ANTILOPE.

THE Scythian antilope has horns a foot long, bending a little in the middle, the points inclining inward, and the ends smooth; the other part is surrounded with very prominent annuli. They are of a pale yellow colour, and the greatest part semipellucid. The length of the animal is four feet nine inches and a quarter; the height before two feet six inches and a half, and behind, two feet seven inches and a half. The tail is three inches long. The head is like that of a sheep; the nose is very large, arched, and marked the whole length with a small line, caused by the elevation of the *septum narium*. The nostrils are tubular and large. The upper lip hangs over the under. The nose is formed of a muscular substance mixed with fat. The cutting teeth are so loose in their sockets as to move with the least touch. The male is covered with rough hair, like the he-goat, and has a very strong smell: the female is smoother. The hair on the bottom of the sides and the throat is long, and resembles wool; that on the sides of the head and neck is hoary. The back and sides are of a dirty white colour. The breast, belly, and inside of the thighs, are of a shining white. The females are hornless and timid; if attacked by wolves or dogs the males place the females in the centre, and defend them stoutly. They bleat like sheep. Their common pace is a trot; when they go faster it is by leaps, and they are swifter than roebucks. When they feed, they lift up the upper mandible, and go backward.

In Hungary, Poland, Tartary, and the southern parts of Siberia, there is a species of goat called *seigah* or *saiga* by the Russians, which, in the figure of the body and the hair, resembles the domestic goat. But the form of its horns and the want of a beard make it approach nearer to the antilopes; and indeed it seems to constitute the shade between these two kinds of animals: for the horns of the saigæ are perfectly similar in figure, transverse rings, longitudinal furrows, &c. to those of the antilope, and they differ in colour only. The horns of all the antilopes are black and opaque; but those of the saiga are whitish and transparent. This animal is mentioned by Gessner under the name of *colus*, and Gmelin under that of *saiga*. The horns in the royal cabinet were sent under the denomination of *horns of the Hungarian buck*. They are so transparent that they are used for the same purposes as shells. In natural dispositions the saiga has a greater resemblance to the antilopes than to the wild and chamois goats; for he does not frequent the mountains; but, like the antilopes, lives on the hills and plains. Like them he is extremely swift, and his motion consists of bounds or leaps. His flesh is also better than that of either the wild or domestic goat.

[In the environs of Sempalat, there are great numbers of *saigi* or *saiga*. This animal has a great resemblance to the roebuck, except that its horns are straight. It is known in no other part of Siberia; for what is called *saiga* in the province of Irkutzk is the musk. The taste of its flesh, it is said, resembles that of the stag.—*Gmelin. Note*—M. Gmelin has since published a more comprehensive description of the saiga, in the first volume of the New Memoirs of the Academy of Petersburg, under the name of the *ibex imberbis;* but he has given no figure of it. M. Gmelin remarks, that this animal has the head of a ram, with a higher and more prominent nose, and the body of a stag, but smaller; for it never reaches the size of a roebuck. The horns are yellowish and transparent, a foot in length, have rings or circles towards the base, and are situated above the eyes. The ears are erect, pretty large, and terminate in a point. In the under jaw there are four cutting, four canine, and five grinding teeth, each of the last having two roots. In the upper jaw there are an equal number of cutting and canine teeth, but only four grinders, each of which has three roots. The neck is pretty long. The hind are longer than the fore legs. The foot is cloven. The female has four paps. The tail is thin, and about three inches long. The hair, like that of the stag, is of a yellowish brown colour on the body, and white under the belly. The female is smaller than the male, and has no horns. Worms breed under their skin. These animals copulate in autumn, and bring forth one or two young in the spring. They live upon herbage, and are very fat when the rutting season commences. In summer they inhabit the plains along the banks of the Irtis. In winter they go to the higher grounds; and they are found not only about the Irtis, but in all the countries watered by the Boristhenes, the Don, and the Wolga. The secretary of the Petersburg Academy adds to what M. Gmelin has remarked, that the saiga goes backward when he feeds. That their horns are purchased by the Chinese to make lanthorns. That they are only found under the 54th degree of latitude; and that, in the east there are none beyond the river Oby.

THE ANTILOPES, OR GAZELLES.

THE horns of the Barbary antilope are twelve inches long, round, inclining first backward, bending in the middle, and then reverting forward at their ends, and annulated with about thirteen rings on their lower part. The upper side of the body is of a reddish brown colour; the lower part and buttocks are white. Along the sides the two colours are separated from each other by a strong dusky line. On each knee there is a tuft of hair.

Of the animals called *antilopes* we know thirteen species, or at least thirteen distinct varieties. In this uncertainty with regard to species and variety, we thought it best to treat of the whole under one article, assigning to each, however, a proper name. The first of these animals is the common *gazelle*, or Barbary antilope, which is found in Syria, Mesopotamia, and other provinces of the Levant, as well as in Barbary, and in all the northern parts of Africa. The horns of this antilope are about a foot in length. They have entire rings at their base, and then half rings till within a small distance from the extremities, which are smooth and pointed. They are not only surrounded with rings, but furrowed longitudinally. The rings mark the years of growth, and they are commonly from twelve to thirteen in number. The antilopes in general, and this species in particular, have a great resemblance to the roebuck in figure, natural functions, nimbleness of movement, vivacity, largeness of the eyes, &c. And as the roebuck exists not in the countries inhabited by the antilope, we would at first be led to conclude that it is only a degenerated roebuck, or that the roebuck is an antilope whose nature has been changed by the effects of climate and food. But the antilopes differ from the roebuck in the substance of their horns. Those of the roebuck are a kind of solid *wood*, which falls off and is renewed annually, like that of the stag. The horns of the antilopes, on the contrary, are hollow and permanent, like those of the goat. Besides, the roebuck has no gall-bladder. The antilopes, as well as the roebucks, have hollows before the eyes. They resemble each other still more in the quality of the hair, in the whiteness of the buttocks, and in the tufts on their legs; but in the roebuck these tufts are on the hind legs, and on the fore legs of the antilopes. Hence the antilopes seem to be intermediate animals between the roebuck and goat. But when it is considered that the roebuck exists equally in both continents, and that the goats, as well as the antilopes, are peculiar to the Old World, we are led to think that the goats and antilopes are more allied to each other than they are to the roebuck. Besides, the only characters peculiar to the antilopes are the transverse rings and longitudinal furrows on the horns; the tufts of hair on the fore legs; a thick and well defined band of black, brown, or reddish hairs below the flanks; and lastly, three stripes of whitish hairs, which extend longitudinally upon the internal surface of the ears.

The second antilope is found in Senegal, where, according to M. Adanson, it is called *kevel*. [The horns of the kevel, or flat-horned antilope, are shaped like those of the last, but flatted on their sides. The rings are more numerous, being from fourteen to eighteen. It is of the size of the roebuck; and in colours and marks resembles the preceding species.—*Pennant.*]

The kevel is less than the common kind, and is nearly of the size of our small roebucks. Its eyes are also larger than those of the gazelle, and its horns, instead of being round, are flattened on the sides. This compression of the horns proceeds not from a difference of sex; for in both males and females the horns of the one species are round, and of the other flat. In every other article the resemblance is complete. The kevel, like the gazelle, has short yellow hair, a white belly and thighs, a black tail, a brown band under the flanks, three white stripes on the ears, black horns surrounded with rings, longitudinal furrows between the rings, &c. The number of these rings, however, is greater in the kevel than in the gazelle; for the latter has generally twelve or thirteen, and the former at least fourteen, and often eighteen.

The third antilope we shall denominate *corine*, from the name *korin*, which it bears, according to M. Adanson, in Senegal. [The corine, or spotted antilope, has very slender horns six inches long, and surrounded with circular *rugæ*. It is less than a roebuck. On each side of the face there is a white line. The neck, body, and flanks, are tawny; the belly and inside of the thighs white, which is separated from the sides by a dark line. On the knees there is a tuft of hair. Some are irregularly spotted with white. Perhaps these are the spotted goats of Kolbe.—*Pennant.*]

This antilope has a great resemblance to the gazelle and kevel. But it is still smaller than the kevel, and its horns are thinner, shorter, and smoother, the rings which encircle them being hardly perceptible. M. Adanson, who communicated to me his description of this animal, says, that it appeared to partake somewhat of the chamois goat, but that it was much smaller, being only two feet and a half long, and less than two feet high; that his ears are four inches and a half in length, the tail three inches, the horns six inches long, and only half an inch thick; that they are two inches asunder at the base, and from five to six at their extremities; that

instead of rings, they have circular *rugæ*, very near each other in the inferior part, and more distant in the superior; that these *rugæ*, which hold the place of rings, are about sixteen in number: that the hair of this animal, which is short, shining, and close set, is yellow on the back and flanks, white on the belly and the inside of the thighs; that the tail is black; and that, in the same species, some individuals have white spots scattered over their bodies without any order.

These differences between the gazelle, the kevel, and the corine, though very conspicuous, seem to be neither essential, nor sufficient to make these animals three distinct species. In every other respect, they resemble each other so strongly, that they appear to be of the same species, varied a little by the influence of climate and food; for the kevel and gazelle differ less from one another than from the corine, whose horns resemble not those of the other two. But all the three have the same natural habits; they go in troops, associate together, and feed in the same manner; their dispositions are gentle; they are easily accustomed to a domestic state; and their flesh makes excellent eating. We may therefore conclude, that the gazelle and kevel certainly belong to the same species, and that it is doubtful whether the corine be a variety only of the same, or really constitutes a distinct species.

In the royal cabinet, there are spoils, either entire or partial, of these three antilopes. We have likewise a horn, which greatly resembles those of the gazelle and kevel, but it is much larger. This horn is also engraven by Aldrovandus. Its thickness and length seem to indicate an animal of greater magnitude than the common antilope; and I imagine it belongs to an antilope called *tzeiran* by the Turks, and *ahu* by the Persians. This animal, says Olearius, has some resemblance to the fallow deer, except that it is reddish, instead of yellow; that its horns have no antlers, and lie on the back, &c. According to Gmelin, who mentions this animal under the name of *dsheren*, it resembles the roebuck, except in its horns, which like those of the wild he-goat, are hollow, and never fall off. This author adds, that, in proportion as the horns grow, the cartilage of the larynx enlarges, and forms a considerable prominence when the animal is old. According to Kempfer, the figure of the *ahu* differs not from that of the stag: but he approaches to the goats by his horns, which are simple, black, and encircled with rings, for more than one half of their length, &c.

[I was shown a kind of deer, called *dsheren* in the language of the country. It resembled the roebuck, except that it had the horns of a wild he-goat, which never fall off. What is singular in this animal, that, in proportion as his horns grow the size of the *larynx* or *pomum Adami*, augments; so that, when old, he has a considerable swelling on his throat. Dr. Messerschmid asserts that this roebuck has an absolute aversion to water. But the inhabitants of Tongus assured me, that, when hunted, he often takes to the water, in order to make his escape; and Brigadier Bucholz at Selenginsck, told me, that he had tamed one completely; that it followed his servant when swimming; and that it often went to an island in the river Selinga, which it never would have done, if it had a natural aversion to water. These roebucks are as swift as the saigas on the borders of the Irtis.—*Voyage de M. Gmelin en Siberie.*—M. Gmelin has since given a more complete description of this animal, in the New Petersburg Memoirs, under the appellation of *caprea campestris gutturosa*, of which the following is an abridgment:—This animal resembles the roebuck in figure, size, colour, and manner of going. It has no cutting teeth in the upper jaw. The male differs from the female by having horns and a protuberance on the throat. The horns are somewhat compressed at the base. They have rings for a great part of their length; they are smooth at the points; and they are blackish, but perfectly black at the extremities. They are permanent, and shed not, like those of the roebuck. Upon the throat of the male, there is a large protuberance of five inches in length, and three in breadth: it is smaller when the animals are young, and is not perceptible till they are near a year old. Its growth keeps pace with that of the horns. This protuberance is occasioned by the structure of the larynx and the orifice of the trachea, which are very large. The female is perfectly similar to the female roe. This animal differs from the *Ibex imberbis*, or *saiga*. The nose of the saiga is large and split like that of the ram; but the nose of this animal is entire and pointed, like that of the roebuck. The Monguls, and even the Russians, call the male *dseren*, and the female *ona*, &c.---The Secretary to the Petersburg Academy adds, that, in the manuscripts of Messerschmid, this animal is mentioned under the names of *ohna*, *dseren*, and *scharchoeschi*.]

Some other travellers have likewise mentioned this species of antilope under the name of *geiran* or *jairan*, which, as well as *dsheren*, may be easily referred to the original name *tzeiran*. This antilope is common in South Tartary, in Persia, and seems also to be found in the East Indies.

[Upon the route from Tauris to Kom, we saw a kind of wild animals, whose flesh was good, and the Persians called them *geirans* or *garzelles*.—*Gemelli Carreri.*---In the deserts of Mesopotamia, there are vast numbers of antilopes, which the Turks call *jairain*.—*La Boullaye-le-Gouz.*

In the forests of Guzarat, every kind of game, or venison, abounds, particularly fallow deer, roebucks, *ahus*, and wild asses.—*Mandelslo.*

To these four species or races of antilopes, we may add other two, which have a great resemblance to them.

The first is called *Koba* in Senegal, where the French gave it the denomination of the *great brown cow*.

[The horns of the Koba, or Senegal antilope, are almost close at the base, and bend out greatly a little above; they approach again towards the ends, and recede from each other towards the points which bend backwards. The distance in the middle is six inches and a half, above that, four inches, at the points six. The length of the horns is seventeen inches, and the circumference at the bottom eight. They are surrounded with fifteen prominent rings, and the ends are smooth and sharp. The head is large and clumsy, being eighteen inches in length; the ears are seven inches long. The head and body are of a light reddish brown. Down the hind part of the neck, there is a narrow black list. The rump is a dirty white. On each knee, and above the fetlock, there is a dusky mark. The hoofs are small. The tail is a foot long, covered with coarse black hairs, which hang far beyond the end. The length of the whole skin, which I bought at Amsterdam, was seven feet.—*Pennant*.]

The second, which we shall call *kob*, is also a native of Senegal, and called the *small brown cow* by the French. The horns of the kob have a great resemblance to those of the gazelle and kevel. But the form of the head is different; the muzzle is longer, and there are no pits under the eyes. [The horns of the *kob*, or Gambian antilope, are thirteen inches long, five inches and a half round at the bottom, very distant in the middle, and pretty close at the base and points. They are surrounded with eight or nine rings, and are smooth at their upper part.—*Pennant*.]

The koba is much larger than the kob. The latter is about the size of a fallow deer; and the former is as large as the stag. From the information of M. Adanson, it appears, that the koba is five feet long from the extremity of the muzzle to the origin of the tail; that the head is fifteen inches long, the ears nine, and the horns from nineteen to twenty; and that the horns are compressed on the sides, and surrounded with eleven or twelve rings; whilst those of the kob have only eight or nine rings, and exceed not a foot in length.

The seventh antilope is found in the Levant, and still more commonly in Egypt and in Arabia. We shall call it by its Arabian name, *Algazel*. [The bezoar antilope has very long, slender, upright horns, bending at the upper part inward towards each other; some of them are much annulated, others smoother. It is of the size of a goat, and is red, mixed with ash-colour. It inhabits the inhospitable and rough mountains of Laar in Persia, and is one of the animals which produce the bezoar.—*Pennant*.] The figure of this animal is nearly the same with that of the other antilopes, and it is about the size of the fallow deer. But its horns are very long, pretty thin, and they bend little toward their extremities. They are black and almost smooth, the rings being very slight, except near the base, where they are better marked. They are near three feet in length, while those of the gazelle or common antilope exceed not one foot; those of the kevel are fourteen or fifteen inches; and those of the corine are only six or seven inches.

The eighth animal is commonly called the *bezoar antilope;* and it is denominated *Pason* by the eastern nations, which last name we shall preserve. [The Egyptian antilope has straight slender horns, near three feet long, and annulated. At their base, there is a triangular black spot, bounded on each side with white. A black line extends from the neck to the loins. The neck, back, and sides, are of a dark gray colour. The breast and belly are white. The tail is about two feet long, terminated with black hairs. The length of the whole skin is six feet.—*Pennant*.] The horns of this antilope are very well represented in the German Ephemerides, and the figure of it is given by Kœmpfer. But, in this figure, the horns are neither sufficiently long nor straight. Besides, his description is by no means exact; for he says that this bezoar animal has a beard like the he-goat, though he has given it no beard in his figure; which is more consonant to truth, the want of a beard being the chief characteristic by which the antilopes are distinguished from the goats. This antilope is of the size of our domestic he-goat, and it resembles the stag in figure, colour, and agility. Beside two separate horns, we have seen a head of this animal to which the horns were attached. The horns engraven in Aldrovandus's work have a great resemblance to those of the pasan. In general, the algazel and pasan seem to be very near allied. They likewise belong to the same climate, and are found in the Levant, Egypt, Persia, Arabia, &c. But the algazel inhabits the plains, and the pasan the mountains. The flesh of both is excellent.

The ninth antilope is an animal, which, according to M. Adanson, is called *nangueur* or *nanguer* in Senegal. It is three feet and a half in length, and two feet and a half in height. It is of the figure and colour of a roe-buck, being yellow on the upper part of the body, white on the belly and thighs, with a white spot under the neck. Its horns are permanent, like those of the other antilopes, and they exceed not six or seven inches in length. They are black and round; but, what is singular, they bend forward at the points, nearly in the same manner as those of the chamois goat bend backward. The nanguer, or swift antilope, is a very handsome animal, and easily tamed. All these characters, and chiefly that of the horns bending forward, incline me to think that the nanguer may be the *dama* or fallow deer of the ancients. Now, the nanguers are the only animals whose horns are bended in this manner; we may therefore presume, that the nanguer of Africa is the dama of the ancients, especially as we learn from

another passage of Pliny, that the dama was found only in Africa. In fine, from the testimony of other ancient authors, we see that the dama was a timid gentle animal, and had no other resources but in the swiftness of its course. The animal described and engraven by Caius under the name of *dama Plinii*, being found, according to the testimony of the same author, in the north of Great Britain and in Spain, could not be the dama of Pliny, since he tells us that it was only to be met with in Africa. Besides, the animal drawn by Caius has a beard like a goat; but none of the ancients mention the dama as having a beard. Hence I am led to think, that the dama described by Caius is only a goat, whose horns being a little bended at the points, like those of the common antilope, made him imagine it to be the dama of the ancients. Besides, the horns bended forward, which is the distinguishing character of the dama of the ancients, are well marked in the nanguer of Africa only. We are likewise informed by M. Adanson, that there are three varieties of those nanguers, which differ only in colour; but all their horns are more or less bended forward.

The tenth gazelle is an animal very common in Barbary and Mauritania, and is called *the antilope* by the British, which name I shall preserve. [The *common antilope* has upright horns, twisted spirally, and surrounded almost to the top with prominent rings: they are about sixteen inches long, and twelve inches distant between point and point. In size it is rather less than the fallow deer or buck. The colour is brown mixed with red, and dusky. The belly and inside of the thighs are white. The tail is short, black above, and white beneath. The females want horns.—*Pennant.*]

It is of the size of our largest roebucks. Though it has a great resemblance to the gazelle and kevel; yet it differs in so many characters that it ought to be regarded as a distinct species. The pits below the eyes are larger in the *antilope* than in the gazelle. Its horns are almost fourteen inches long; and though they nearly touch at the base, yet their points are fifteen or sixteen inches asunder. They are surrounded with rings and half rings, which are less raised than those of the gazelle and kevel; and what is peculiar to the *antilope*, its horns have a remarkably beautiful double flexion, which gives them the appearance of the ancient lyre. The hair of the *antilope*, like that of the other gazelles, is yellow on the back, and white on the belly: but these two colours are not separated below the flanks by a brown or black band, as in the gazelle, kevel, corine, &c. We have only a skeleton of this animal in the royal cabinet.

In the *antilope*, as well as the other gazelles, there seem to be different races. 1. In the royal cabinet there is a horn which can only be attributed to an antilope of a much larger size than that we have been describing. We shall adopt the name *lidmee*, which, according to Dr. Shaw, the Africans apply to the *antilopes*.

[The Lidmée, or brown antilope, is less than a roebuck; its horns resemble those of the last. Its face, back, and sides, are of a very deep brown, the last bordered with tawny. The belly and inside of the legs are white. Above each hoof there is a black spot. The tail is black above, and white beneath.—*Pennant.*

Besides the common gazelle or antilope, (which is well known in Europe,) this country likewise produceth another species, of the same shape and colour, though of the bigness of our roebuck, and with horns sometimes of two feet long. This the Africans call *lidmee*, and may, I presume, be the *strepsicheros* and *adace* of the ancients.—*Shaw's Travels.*]

2. We have seen in the cabinet of the Marquis de Marigny, whose taste extends both to the fine arts and to the history of nature, a kind of offensive weapon, composed of two sharp horns, about a foot and a half long, which, from their double flexion, appear to belong to an *antilope* smaller than the others. It must be very common in India; for the priests carry this kind of weapon as a mark of dignity. We shall call it the *Indian antilope*, because it appears to be only a simple variety of the African species.

[The Indian antilopes are not entirely like those of other countries. They have more spirit; and are distinguishable by their horns. In the common antilopes the horns are gray, and not half so long as those of India, which are black, and more than a foot and a half in length. They are twisted as far as the points like a screw. The faquirs and santons generally carry two of them joined together in a parallel direction, and use them as small batons.—*Thevenot.* Those in the Marquis de Marigny's cabinet are neither twisted nor annulated: they seem to have been polished from one end to the other.]

Thus among the gazelles or antilopes we have discovered twelve species, or distinct varieties. 1. The common gazelle; 2. The kevel; 3. The corine; 4. The tzeiran; 5. The koba, or great brown cow; 6. The kob, or small brown cow; 7. The algazel, or Egyptian antilope; 8. The pasan, or pretended bezoar animal; 9. The nanguer, or dama of the ancients; 10. The *antilope*; 11. The lidmée; 12. The Indian *antilope*. After a careful comparison of these twelve animals among themselves we are led to conclude, 1. That the common gazelle, the kevel, and the corine, are only three varieties of the same species; 2. That the tzeiran, koba, and kob, are varieties of another species; 3. That the algazel and pasan are probably two varieties of the same species; and that the name of *bezoar gazelle*, which has been given to the pasan, is not a distinctive character; for I shall afterwards prove, that the oriental bezoar is not produced by the pasan alone, but by all the gazelles and goats which inhabit the mountains of Asia; 4. That the nanguers, whose horns are bended forward, and of which

there are two or three varieties, have been pointed out by the ancients under the name of *dama;* 5. That the *antilopes*, which are three or four in number, and differ from all others by the double flexion of their horns, were likewise known to the ancients, and mentioned under the names of *strepsicheros* and *addax*. All these animals are found in Asia and Africa. To these five principal species, which contain twelve varieties, I will not add two or three other species of the New World, to which the vague name of *gazelle*, or *antilope*, has been given, though they differ from all those formerly taken notice of. This would be to augment a confusion which is already too great. In the subsequent article we shall give the history of these American animals under their true names *mazame*, *temamacame*, &c. and shall here confine ourselves entirely to the animals of this genus which are found in Africa and Asia: for the same reason we shall refer to the following article several other African and Asiatic animals, which have been regarded as antilopes or goats, though they appear to be intermediate species, such as the bubalus, or Barbary cow, the condoma, the guib, the grimm, &c. without including the chevrotains or musks, which have a great resemblance to the smallest goats or antilopes: of these last we shall likewise make a separate article.

It is now easy to perceive the difficulty of arranging and distinguishing all these animals, which are thirty in number, ten goats, twelve or thirteen antilopes, three or four bubali, and as many musks. Many of them were unknown to the naturalists, or exhibited in promiscuous groups; and the whole have been confounded with each other by travellers. This, indeed, is the third time I have written the history of these animals; and I acknowledge that the labour overbalanceth the produce. I have the satisfaction, however, of having made every possible use of the knowledge and materials I could acquire.

Dr. Russel, in his Natural History of Aleppo, tells us, that in the neighbourhood of that city there are two kinds of gazelles; the one, called the *mountain gazelle*, which is the most beautiful, and whose hair on the neck and back is of a deep brown colour; the other, called *the gazelle of the plains*, which is neither so nimble nor so handsome as the first, and whose hair is of a pale colour. He adds, that these animals are so swift, and run so long, that the best hounds cannot take them without the assistance of a falcon; that though the gazelles are meagre in winter their flesh is excellent; that in summer it is loaded with fat like that of the fallow deer; that those fed in houses are not such good eating as the wild ones, &c. From the testimonies of Mr. Russel and of Hasselquist, we learn that the gazelles of Aleppo are not the common kind but the Egyptian gazelles, whose horns are upright, long, and black, and whose flesh is extremely good; and that they are half-domestic, having been often and very anciently tamed, which of course has given rise to a great number of varieties, or different races, as happens in all other domestic animals. These Aleppo gazelles, therefore, are the same with those we have called *algazelles*. They are still more common in Thebaid and Upper Egypt than in the environs of Aleppo. They feed upon aromatic herbs, and the buds of trees. They generally go in flocks, or rather in families, consisting of five or six. Their cry is similar to that of the goat. They are not only hunted with hounds, who are assisted by falcons, but by the small panther, which we have called the *ounce*. In some places the gazelles are taken by means of tamed ones, with snares of ropes fixed to their horns.

[The rock goat is larger, swifter, and wilder than the common rock goat, and can scarcely be taken without a falcon. It is met with near Aleppo. I have seen a variety of this, which is common in the east, and the horns appear different; perhaps it is a distinct species. This animal loves the smoke of tobacco, and when caught alive will approach the pipe of the huntsman, though otherwise more timid than any animal. This is perhaps the only creature beside man that delights in the smell of a poisonous and stinking plant. The Arabians hunt it with a falcon. I had an excellent opportunity of seeing this sport in Nazareth in Galilee. An Arab, mounting a swift courser, held the falcon on his hand as huntsmen commonly do: when we espied the rock goat, on the top of a mountain, he let loose the falcon, which flew in a direct line, like an arrow, and attacked the animal, fixing the talons of one of his feet into the cheek of the creature, and the talons of the other into its throat, extending his wings obliquely over the animal; spreading one towards one of its ears, and the other to the opposite hip. The animal thus attacked made a leap twice the height of a man, and freed himself from the falcon; but being wounded, and losing its strength and speed, it was again attacked by the falcon, which fixed the talons of both its feet into the throat of the animal, and held it fast, till the huntsman coming up took it alive, and cut its throat; the falcon drinking the blood as a reward for his labour; and a young falcon, which was learning, was likewise put to the throat of the goat; by this means are young falcons taught to fix their talons in the throat of the animal, as being the properest part; for should the falcon fix them in the creature's hip, or some other part of the body, the huntsman would not only lose his game but his falcon also: for the animal, roused by the wound, which could not prove mortal, would run to the deserts and the tops of the mountains, whither its enemy, keeping its hold, would be obliged to follow; and being separated from its master must of course perish.—*Hasselquist*.

[In Egypt there are a number of antilopes.—They commonly traverse the mountains in flocks. The hair and tail of these animals resemble those of the hind; and their fore-feet, which are short, resemble those of the fallow deer. Their horns are straight as far as the extremity, which is crooked. Their cry resembles that of the other goats.—*Paul Lucas.*

In India there are numbers of gazelles, which resemble our fawns. They generally go in separate flocks, each consisting of five or six, and accompanied with a male, who is easily distinguished by his colour. When the hunters discover one of these flocks, they endeavour to point them out to the leopard, which they keep chained in a small cart. This cunning animal does not run straight upon them, but winds about, creeping and concealing himself in order to approach and surprise them; and, as he is capable of making five or six bounds with inconceivable quickness, when he thinks himself near enough, he darts upon them, tears open the throat and breast, and gluts himself with their blood, heart, and liver. But, if he misses his aim, which often happens, he remains fixed on the spot. It would be in vain to attempt to seize them by running; for they run much swifter and continue much longer than he can do. His master then comes gently up to him, flatters him, and throws pieces of flesh to him. By amusing the animal in this manner, he is enabled to throw a cover over his eyes: after which he chains him, and replaces him on the cart. In the course of our march, one of these leopards exhibited this sport to us, which alarmed several of our people. A flock of gazelles rose in the midst of the army, and, as often happens, they accidentally passed near the two leopards, which are commonly carried along on a small cart. One of them, which was not hood-winked, made such a spring, that he broke his chain, and darted after them, but without effect. However, as the gazelles were terrified, and chased on all sides, one of them was again obliged to pass near the leopard, who, notwithstanding the whole road was embarrassed with camels and horses, and notwithstanding the common notion that this animal never attacks its prey after having once missed it, he sprung upon and seized it.—*Thevenot.*

Instead of a leopard, a tamed gazelle is employed to catch the wild ones. Round his horns a rope is twisted in various directions, and the two ends of it are fixed under his belly. When the hunters discover a flock of gazelles, he is allowed to go and join them. But the male of the little flock advances to prevent him: this opposition he makes with his horns, which are soon entangled in the mesh of ropes. He is then seized and carried off by the hunters.—*Idem.*---The same art is employed in taking the females. A domestic female with a netting of cords is let loose among a flock. The wild females immediately begin to sport with her; and the horns of one of them are soon entangled; and she falls an easy prey to the indians.—*La Boullaye-le-Gouze.*]

The antilopes, especially of the larger kinds, are much more common in Africa than in India. They are stronger and fiercer than the other gazelles; and they are easily distinguished by the double flexion of their horns, and by the want of a black or brown band below the flanks. The middling antilopes are of the size of a fallow deer. Their horns are very black, their belly pure white, and their fore legs are shorter than the hind legs. They are very numerous in Tremecen, Duguela, Tell, and Zaara. They are cleanly animals, and never lie down but in dry places. They are also extremely nimble, vigilant, and timorous. In open places, they look round on all sides; and, as soon as they perceive a man, a dog, or any other enemy, they fly off with full speed. But, notwithstanding this natural timidity, they have a kind of courage; for, when surprised they stop short, and face those who attack them.

In general, the eyes of the gazelles are black, large, vivacious, and at the same time, so beautiful, that, in the Eastern nations, they are employed proverbially in praising the eyes of a fine woman. Their limbs are finer and more delicate than those of the roebuck. Their hair is short, soft, and lustrous. Their fore legs are not so long as the hind ones, which enables them, like the hare, to run with greater facility up than down hill. Their swiftness is equal to that of the roebuck; but the latter rather leaps than runs, whereas all the gazelles run uniformly. Most of them are yellow on the back and white on the belly, and have a brown band which separates these two colours below the flanks. Their tails are of different lengths, but always garnished with pretty long black hair. Their ears are long, erect, pretty open in the middle, and terminate in a point. Their feet are cloven, and shaped nearly like those of the sheep. Both males and females have permanent horns; but those of the females are thinner and shorter.

These are all the facts we have been able to collect concerning the different species of gazelles, and their natural dispositions and manners. We shall now inquire with what propriety naturalists have ascribed to one of these animals only, the production of the famous stone, called the *oriental bezoar*, and whether this animal be the *pasen* or *pazan*, which they have mentioned specifically under the name of the *bezoar gazelle*. In examining the figures and description given by Kœmpfer, who has written much on this subject, it is doubtful whether he means that the pazan or the algazel is the only animal which produces the *oriental bezoar*. If we consult the other naturalists and travellers, we shall be tempted to believe that all the gazelles, wild and domestic goats, and even the sheep, indiscriminately produce this stone, the formation of which depends more,

perhaps, on the temperature of the climate, than on the nature or species of the animal. If we may believe Rumphius, Seba, and some other authors, the true oriental bezoar proceeds from apes, and not from gazelles, goats, or wedders. But this notion of Rumphius and Seba is by no means well founded. We have seen several of these concretions, which are called *ape bezoars*. But they are totally different from the oriental bezoar, which unquestionably proceeds from a ruminating animal, and is easily distinguished, by its form and substance, from all the other bezoars. Its common colour is a greenish olive, and brownish within. The colour of what is called the *occidental bezoar*, is a faint yellow, more or less dirty. The substance of the former is more tender and porous, and that of the latter, harder, drier, and more petrified. Besides, as prodigious quantities of the oriental bezoar were consumed during the last two or three centuries, being used, both in Europe and Asia, in all cases where our physicians now employ cordials and antidotes against poison, may we not presume, from this great consumption, which still continues in some degree, that the bezoar proceeds from a very common animal, or rather, that it proceeds not from one, but from several species; and that it is equally extracted from gazelles, goats, and wedders; but that these animals can only produce it in the climates of India and the Levant?

[At Golconda, the king has great store of excellent bezoars. The mountains where the goats feed which produce these stones are about seven or eight days journey from Bagnagaar. They commonly sell at forty crowns a pound; and the longest kind are the best. They are likewise found in certain cows, which are much larger, though not so valuable, as those produced by the goats. The bezoars extracted from a rare kind of apes, which are small and long, are in the highest estimation. ---*Thevenot.* Persia produces finer bezoar stones than any other country of the world. They are extracted from the sides of certain wild he-goats, to the livers of which they are attached.—*Feynes.* The bezoar, that famous medicinal stone, ought to be ranked among the number of drugs. It is a tender stone, consisting of coats or pellicles, like an onion. It is found in the bodies of the wild and domestic goats along the gulf of Persia, in the province of Corasson, which is the ancient Margiana, and is incomparably better than that brought from the kingdom of Golconda. But, as the goats were brought from a distance of three days journey, we found bezoars in some of them only, and even that in small quantities. We preserved these goats alive fifteen days. They were fed with common green herbage; but, upon opening them, nothing was found. I kept them during this time, in order to discover whether, as is alledged, it be a particular herb which heats these animals, and produces this stone in their bodies. We are told by the natives of Persia, that the more this animal pastures in parched countries, and eats dry and aromatic herbs, the bezoar is the more salutary. Corasson and the borders of the Persian gulf are the driest countries in the world. In the heart of these stones, there are always pieces of brambles, or some other vegetable, that serve as a nucleus, round which the humour that composes this stone coagulates. It is worthy of remark, that, in India, the she-goats produce bezoar, and that, in Persia, it is produced by the wedders and he-goats. The Persians esteem their own bezoar, being hotter and better concocted, as four times more valuable than the Indian kind. The former they sell at fifty-four livres the kourag, which is a weight of three drachms.—*Chardin.* The oriental bezoar comes from a northern province of the kingdom of Golconda, and is found in the stomach of the she-goats.---The peasants, by feeling the belly of the goat, know how many bezoars she has, and sell her in proportion to their number. This number they discover, by rubbing the sides of the stomach with their hands in such a manner as to bring all the contents towards the middle of it, and then they feel the stones distinctly.---The bezoar, like the diamond, is valued according to its size; for, if five or six bezoars weigh an ounce, they bring from fifteen to eighteen francs. But, if one bezoar weighs an ounce, it sells at one hundred francs. I sold one of four ounces and a half at two thousand livres.---The merchants who traffic in bezoars, brought me six of these goats, which I examined. It must be acknowledged that these animals are beautiful, very tall, and have hair as fine as silk.---I was told that one of these goats had but one bezoar in its stomach, and that others had two, three, or four, which I soon perceived to be true, by rubbing their bellies in the manner above described. These six goats had seventeen bezoars and a half, one of which was about the size of half a hazel nut. The inside resembled the soft dung of a goat. These stones grow among the dung in the animal's belly. Some of the natives told me, that the bezoars were attached to the liver, and others, that they were fixed in the heart. From these vague assertions, I could not learn the truth.---With regard to the bezoar produced by the ape, it is so strong that two grains of it are reckoned equal to six of that produced by the goat; but it is very rare, and is found principally in the island of Macassar. This kind of bezoar is round; but the other is of different figures. These bezoars which are supposed to come from the apes, are much rarer than the other kind. They are also much dearer, and in greater request; and, when one is found of the size of a nut, it sometimes sells at more than a hundred crowns.—*Tavernier.*]

From all that has been written on this subject we have not been able to find one distinct observation, nor a single decisive argument. It only appears, from what has been said by Monard, Garcias, Clusius, Aldrovandus,

Hernandes, &c. that the oriental bezoar animal is not the common domestic goat, but a species of wild goat which they have not sufficiently characterised. In the same manner all we can collect from Kœmpfer is, that the bezoar animal is a kind of wild goat, or rather gazelle, which is equally ill described. But from the testimonies of Thevenot, Chardin, and Tavernier, we learn, that this stone is not so often extracted from the gazelles, as from the wedders, and the wild or domestic goats. These travellers merit the greater credit, because they were eye-witnesses to the facts they mention, and because when treating of the bezoar, though they take no notice of the gazelles, yet as they are well acquainted with these animals, and mention them in other parts of their works, there is not the least appearance of their having been deceived. We must not, therefore, conclude, like our ancient naturalists, that the oriental bezoar is produced solely by a particular species of gazelle. I acknowledge, that after having examined not only the evidence of travellers, but the facts themselves which might decide this question, I am inclined to believe that the bezoar stone proceeds equally from the most part of ruminating animals, but more commonly from goats and gazelles. It is formed of concentric coats or strata, and frequently contains foreign substances in its centre. I endeavoured to investigate the nature of these substances, which serve as a nucleus to the bezoar, in order to discover the animal that swallowed them. In the centre of these stones I found small flints, stones of plums, and of tamarinds, seeds of cassia, and especially pieces of straw and buds of trees. Hence I could no longer hesitate in attributing this production to animals which browse herbage and leaves.

We are persuaded, therefore, that the oriental bezoar proceeds not from any one, but from a number of different animals. Neither is it difficult to reconcile this opinion with the testimonies of travellers; for though each of them contradicts his neighbour, yet all of them make near approaches to the truth. The bezoar was unknown to the ancient Greeks and Latins. Galen is the first who mentions its virtues against poison. The Arabians speak of the bezoar as possessing the same virtues. But neither the Greeks, Latins, nor Arabians, give any precise information concerning the animals by which it is produced. Rabi Moses, the Egyptian, only remarks, that some people pretend that this stone is formed in the angle of the eye, and others in the gall bladder of the eastern wedders. Now bezoars or concretions are actually formed in the angles of the eyes, and in the pits below the eyes of stags and some other animals. But these concretions are very different from the oriental bezoar; and all the concretions in the gall-bladder consist of a light, oily, and inflammable matter, which has no resemblance to the substance of the bezoar. Andreas Lacuna, a Spanish physician, in his commentaries on Dioscorides, remarks, that the oriental bezoar is extracted from a certain species of wild goat in the mountains of Persia. Amatus Lusitanus repeats Lacuna's remark; and adds, that this mountain goat resembles the stag. Monard, who quotes all the three, assures us in a more positive manner, that this stone is derived from the internal parts of a mountain goat in India, to which, says he, I may give the appellation of *cervi-capra;* because it partakes both of the stag and the goat, is nearly of the size and figure of the stag, and, like the goat, has simple horns, very much bended backward. Garcias ab Horto tells us, that in Corasson and in Persia there is a species of he-goats, called *pasan;* that the oriental bezoar is generated in their stomach; that this stone is found not only in Persia, but likewise in Malacca, and in the Island of Cows near Cape Comorin: and that in great numbers of these goats slain for the subsistence of the troops, these stones were very commonly found. On this subject Christopher Acosta repeats what has been said by Garcias and Monard, without offering any thing new. In fine, to omit nothing relative to the history of this stone, Kœmpfer, an intelligent man, and an exact observer, tells us, that when in the province of Laar in Persia, he went with the natives of the country to hunt the buck *pasan*, which produces the bezoar; and that he saw the stone extracted; and he assures us, that the true oriental bezoar proceeds from this animal; that the buck *ahu*, of which he also gives a figure, likewise produces bezoar, but that it is of an inferior quality. From the figures he has given of the pason and ahu, we would be induced to think, that the first represents the common gazelle rather than the true pasan; and from his description we should imagine his pasan to be a he-goat, and not a gazelle, because he has given it a beard like the goats. Lastly, from the name *ahu*, which he gives to his other buck, as well as from his second figure, we recognise the wild he-goat rather than the genuine ahu, which is our tzeiran or large gazelle. What is still more singular, Kœmpfer, who seems willing to determine the species of the oriental bezoar animal, and who assures us that it is the wild buck called *pasan*, quotes at the same time a man who, he says, is very worthy of credit, and who affirms, that he felt the bezoars in the belly of the gazelle at Golconda. Thus all the positive evidence which can be derived from Kœmpfer is reduced to this, that there are two species of wild mountain goats, the pasan and ahu, which produce the bezoar in Persia, and that in India this stone is likewise found in the gazelles. Chardin remarks, that the oriental bezoar is found in the bucks and she-goats, both wild and domestic, along the Persic Gulf, and in several provinces of India; but that in Persia it is also extracted from the wedders. The Dutch travellers also assert, that it is produced in the stomachs of sheep and goats.

[In the island of Bosner we find the famous bezoar stone, which is very precious and in great request, on account of its virtue against poison. It is formed in the stomachs of sheep or goats, round a small pustule or protuberance in the middle of the stomach, and which is found in the stone itself. A conjecture has been formed that the bezoar which proceeds from the stomach of the sheep, and the gall-bladder stone of the hog, are produced by the operation of some particular herbs eaten by these animals. But they are found in all the countries of the East Indies, though these animals feed promiscuously upon herbage of every kind.—*See Voyage de la Comp. des Indes d'Hollande,* and also *Le Voyage de Mandelslo.*]

Tavernier, who is still more positive in favour of the domestic goats, says, that their hair is as fine as silk, and that, having purchased six of these goats alive, he extracted from them seventeen entire bezoars, and a piece of another as large as half a filberd nut. He then adds, that there are other bezoars supposed to proceed from apes, whose virtues are still stronger than those of the goat-bezoars; that they are also extracted from cows; but the virtues of these are inferior, &c. What can be inferred from this variety of evidence and opinions, unless it be allowed that the oriental bezoar proceeds not from one species, but from a number of different animals, and especially from the gazelles and goats?

With regard to the occidental bezoars, we hesitate not to pronounce, that they are produced neither by goats nor gazelles; for it will be shown in the subsequent articles, that there are neither goats, gazelles, nor even any animal which approaches to this genus throughout the whole extent of the New World. Instead of gazelles we find roebucks alone in the woods of America; instead of wild goats and sheep, lamas and pacos, animals totally different are to be found in the mountains of Peru and Chili. The ancient Peruvians had no other cattle; and at the same time that these two species were partly reduced to a domestic state, they existed in still greater numbers in their natural condition of liberty on the mountains. The wild lamas were called *huanacus*, and the pacos *vicunnas*, from which has been derived the name *vigogne*, that denotes the same animal with the pacos. Both the lamas and the pacos produce bezoars; but the domestic kind produce them more rarely than the wild.

M. Daubenton, who has investigated the nature of bezoar stones more closely than any other person, thinks that they are composed of the same matter as that shining coloured tartar which adheres to the teeth of ruminating animals; and it appears, from the numerous collection of bezoars in the royal cabinet, that there are essential differences between the oriental and occidental bezoars. Hence the goats of the East Indies, and the gazelles of Persia, are not the only animals which produce the concretions called bezoars. The chamois, and perhaps the wild goat of the Alps, the he-goats of Guinea, and several American animals, likewise produce bezoars: and under this name, if we comprehend all similar concretions found in the intestines of animals, we may affirm, that most quadrupeds, except those of the carnivorous kinds, and even the crocodiles and large serpents, produce bezoars.

[There is another stone, called the *stone of the hooded serpent,* a species of serpent which has a kind of hood hanging behind its head, and behind this hood the stone is found, the smallest being as large as a hen's egg. These serpents frequent the coasts of Melinda, and the stones might be brought by the Portuguese sailors or soldiers, when they return from Mosambique.—*Tavernier.*]

To obtain a clear idea of these concretions, they must be distributed into several classes, referring to the animals which produce them, and the climates and food that are favourable to their production.

1. The stones formed in the bladder and kidneys of men and other animals must be separated from the class of bezoars, and denominated by the appellation of *calculi*, their substance being totally different from that of the bezoars. They are easily distinguished by their weight, their urinous odour, and their structure, which is neither regular nor composed of thin concentric circles, like that of the bezoars.

2. The concretions sometimes found in the gall-bladder and liver of men and animals should not be regarded as bezoars. They may be distinguished by their lightness, their colour, and their inflammability; besides, they are not formed of concentric circles round a nucleus.

3. The balls frequently found in the stomachs of animals, and especially of the ruminating kinds, are not true bezoars. These balls, which are called *ægagropili*, are composed internally of hairs swallowed by the animal when licking itself, or of hard roots which it was unable to digest; and, externally, most of them are covered with a viscid substance, which has some resemblance to bezoar. Hence the *ægagropili* have nothing in common with the bezoars but this external covering; and inspection alone is sufficient to distinguish the one from the other.

4. In temperate climates we often find *ægagropili* in animals, but never bezoars. Our oxen and cows, the Alpine chamois, and the Italian porcupine, produce only *ægagropili*. The animals of hot countries, on the contrary, yield only bezoars. The elephant, the rhinoceros, the goats and gazelles of Asia and Africa, the lama of Peru, &c. instead of *ægagropili*, produce solid bezoars, whose size and consistence vary according to the animals, and the climates under which they live.

[We found an ægagropilus in a porcupine sent us from Rome in the year 1763.]

5. The bezoars to which so many virtues have been ascribed are the oriental kind, and they are produced by the goats, gazelles, and sheep, that inhabit the high mountains of Asia. Bezoars of an inferior quality, which are called *occidental*, proceed from the lamas and pacas which are found in the mountains of South America. In fine, the goats and gazelles of Africa likewise yield bezoars; but they are not so good as those of Asia.

From all these facts we may conclude, in general, that the bezoars are only a residue of vegetable nourishment, which exists not in carnivorous animals, and is peculiar to those who live upon plants; that in the southern mountains of Asia, the herbs being stronger and more exalted than in any other region of the world, the bezoars, which are the residue of them, are also superior in quality to all others; that in America, where the heat is less intense, and the mountain herbs have not so much strength, the bezoars which proceed from them are also greatly inferior; and lastly, that in Europe, where the herbs are feeble, and in the plains of both continents, where they are gross, no bezoars are produced, but only *ægagropili*, which contain nothing but hairs, roots, or filaments that are too hard to be digested.

The BUBALUS, or CERVINE ANTILOPE, and other Animals allied to the Gazelles or Goats.

THE BUBALUS.

THE porcine antilope, with horns bending outward and backward, almost close at their base, and distant at their points; twisted and annulated; very strong and black; some of them are above twenty inches long, and above eleven in girth at the base. The head is large, and like that of an ox. The eyes are placed very high, and near the horns. The form of the body is a mixture of the stag and heifer. It is of the size of the former. The tail is rather more than a foot long, and terminated with a tuft of hair. The colour is a reddish brown.

In the article buffalo, we remarked, that the modern Latins had improperly applied to it the name *bubalus*. This appellation anciently belonged to the animal we are now treating of, whose nature is very different from that of the buffalo. In some external qualities it resembles the stag, the gazelles, and the ox. It resembles the stag in size and figure, and particularly in the form of its limbs: but its horns are permanent, and nearly constructed like those of the largest gazelles, to which it is allied by this character as well as its natural dispositions. Its head, however, is much longer than that of the gazelles, or even that of the stag. In fine, it resembles the ox in the length of the muzzle, and in the disposition of the bones of the head, which, as in the ox, jut not out behind farther than the frontal bone. These relations in external structure, joined to its ancient name being forgotten, are the reasons why in modern times it has obtained the compound denominations of *busephalus*, *bull-stag*, bucula-cervina, *cow hind*, *Barbary cow*, &c. Even the name *bubalus* comes from bubulus, and has been applied to it on account of the similarity of this animal to the ox.

The head of the bubalus is narrow; the eyes are placed very high; and the front is short and narrow. The horns are large, black, permanent, and furnished with large rings. They spring near each other, but recede considerably at their extremities. They bend backward, and are twisted spirally. His shoulders are so high, that they form a kind of bunch on the withers. The tail is nearly a foot long, and garnished with a tuft of hair at the point. The ears are similar to those of the *antilope*. Kolbe has given to this animal the appellation of *elk*, though it has no other resemblance to the elk than by its hair being more slender at the root than in the middle, or at the point, which is peculiar to these two animals; for in almost every quadruped the hair is always grosser at the root than in the middle, or at the point. The hair of the bubalus is nearly of the same colour with that of the elk, though it is much shorter, softer, and less bushy. These are the only resemblances between the elk and bubalus; for they differ in every other particular. The horns of the elk are larger and heavier than those of the stag, and are likewise renewed annually. The horns of the bubalus, on the contrary, never fall off, but continue to grow during life, and resemble in figure and texture those of the gazelles. He resembles the gazelles still more in the figure of his body, the lightness of his head, the length of his neck, the position of his eyes, ears, and horns, and in the form and length of his tail. The gentlemen of the Academy of Sciences, to whom this animal was presented under the name of the *Barbary cow*, and who adopted that

denomination, have not failed to recognize it to be the *bubalus* of the ancients. Though we have rejected this compound appellation, we hesitate not to copy here their exact description, by which it appears that this animal is not a gazelle, a goat, a cow, an elk, or a stag, but that it is a particular and distinct species. Besides, it is the same with that described by Caius, under the name of *buselaphus;* and I was surprised that the gentlemen of the Academy omitted this remark, as all the characters ascribed by Caius to his *buselaphus* correspond with their Barbary cow.

[The African elk.—Its head is beautiful, and resembles that of the stag, but it is smaller in proportion to the size of the body. Its horns are about a foot in length. Near the head they are rugged, but straight, uniform, and pointed at the extremities. Its neck is free and beautiful. The upper lip is a little larger than the under. Its limbs are long, thin and delicate; and its tail is about a foot in length. The hair which covers its body is soft, smooth, and of an ash-colour.—The African elk weighs about four hundred pounds.—*Kolbe's Descript.*

The habit of body, the legs, and the neck of this animal, give it a stronger resemblance to a stag than to a cow of which last he has only the horns, and even these differ considerably from those of the cow. They spring very near each other; because the head is here extremely narrow; but, in the cow, the front is very large. They were about a foot long, black, bended backward, twisted spirally, and so used before and above, that the elevations of the screw were almost entirely effaced. The tail exceeded not thirteen inches in length, including the tuft of hair at the point, which was three inches long. The ears resembled those of the gazelles, the inside being garnished, in some places, with white hair; the rest was naked, and exhibited a skin perfectly black and smooth. The eyes were high and so near the horns, that the head seemed to have no front. There were only two very thin, short teats, which render this animal very different from our cows. The shoulders were so high, that they formed a kind of bunch on the withers.—This animal seems rather to be the bubalus of the ancients than the small African ox described by Belon; for Solinus compares the bubalus to the stag; Oppian gives him horns turned backward; and Pliny says, that he partakes of the calf and stag.—*Mem. pour servir a l'hist. des animaux.*]

[The bubalus is separated from the stag-kind by two essential characters: 1. The horns never shed; 2. The bubalus has a gall-bladder, which is wanting in the stag, the fallow deer, the roebuck, &c. 'The gall-bladder,' say the gentlemen of the academy, 'was placed on the right side; its internal half was attached to the liver, and the membrane which formed the external half was thin, delicate, and folded, being entirely void of gall.'—*Idem.*

In the Royal Cabinet there is, 1. A skeleton of the bubalus, which had been described and dissected by the gentlemen of the Academy; 2. A head, which is much larger than that of the skeleton, and the horns are also thicker and longer; 3. A portion of another head, with horns as large as the former, but whose figure and direction are different. Hence, in the bubali, as well as in the gazelles, antilopes, &c. there are varieties in the size of the body and the figure of the horns. But these differences seem to be too inconsiderable to constitute distinct species.

The bubalus is very common in Barbary, and in all the northern parts of Africa. He has nearly the same dispositions with the antilopes; and, like them, his hair is short, his skin black, and his flesh is good to eat.

THE CONDOMA, OR STRIPED ANTILOPE.

THE striped antilope has smooth horns twisted spirally, compressed sidewise, with a ridge on one side following the wreaths; they consist of three bends, are three feet nine inches long, and of a pale brown colour; they are close at the base, and two feet seven inches and a half distant at the points, which are round and sharp. In the upper jaw, there is a hard horny substance disposed in ridges. The length of the animal is nine feet, and the height four. The body is long and slender; the legs are slender, the face is brown and marked with two white lines proceeding from the corner of each eye, and uniting above the nose. The colour in general is of a reddish cast, mixed with gray. From the tail, along the top of the back, to the shoulders, there is a white stripe; from this are seven others, four pointing towards the thighs, and three towards the belly. On the upper part of the neck is a short mane. Beneath the neck, from the throat to the breast, are some long hairs hanging down. The breast and belly are gray. The tail is two feet long, brown above, white beneath, and black at the end.

The Marquis de Marigny, who never loses an oppor-

tunity of encouraging arts and sciences, showed me in his cabinet the head of an animal, which, at first sight, I took to be that of a large bubalus. It resembles the head of our largest stags. But, instead of solid horns, like those of the stag, it had two large hollow horns, with a ridge like those of the he-goat, and a double flexion, like those of the antilopes. In searching the Royal Cabinet, I found two horns which belonged to this animal. The first had been brought from the King's wardrobe, without any title or name. The second I had from M. Baurhis, commissary of the navy, under the name of the *condoma* of the Cape of Good Hope; which name we have adopted, because the animal has not hitherto been described or denominated.

From the length, thickness, and especially the double flexion of the horns, the condoma makes a near approach to the *strepsiceros* of Caius. The figure, and even all the dimensions of the horns, are almost perfectly the same. From this correspondence in the size and figure of the head and horns, we may presume that the condoma and *strepsiceros* of Caius are the same animal, especially when the following reflections are attended to: 1. Caius, it is obvious, was deceived, when he made this animal the *strepsiceros* of the ancients; for the *strepsiceros* of the ancients is unquestionably the *antilope*, whose head is very different from that of the stag. Now Caius tells us, that the head of the strepsiceros resembled that of the stag; and, therefore, it could not be the strepsiceros of the ancients. 2. Caius's animal, like the condoma, had thick horns, about three feet long, covered with rugosities, instead of rings or tubercles; but the horns of the strepsiceros of the ancients, or *antilope*, are much thinner and shorter, having both rings and tubercles. 3. Though the horns of the condoma in the cabinet of the Marquis de Marigny, as well as those which were brought from the King's wardrobe, had been polished by friction, it is easy to perceive that they never had rings. This fact is farther demonstrated by the horn sent to me by M. Baurhis, which had never been touched, and yet it had only rugosities like the he-goat, and no rings like the *antilope*. Now, Caius himself tells us, that the horns of his strepsiceros had rugosities only. Hence this strepsiceros is not that of the ancients, but the animal we are here treating of, which possesses all the characters which Caius attributes to his.

In examining the writings of travellers, we have found nothing that approaches so near to the genuine idea of this animal, which is so remarkable for its size, and particularly the largeness of its horns, as the quadruped mentioned by Kolbe under the denomination of the *wild goat* of the Cape of Good Hope. 'This goat,' says he, 'which has received no name from the Hot-'tentots, and which I have called the *wild goat*, is re-'markable in many respects. It is of the size of a large 'stag; its head is very beautiful, and adorned with two 'smooth horns, which are bended and pointed. They 'are three feet in length, and their extremities are two 'feet asunder.' These characters seem to correspond exactly with the animal under consideration: but, having seen the head only, we cannot be equally certain that the rest of Kolbe's description will apply to it with equal precision. Future observations alone can determine the truth of what now appears to be extremely probable.

[From the front, and along the whole back, as far as the tail, there is a white stripe; another, of the same colour surrounds the lower part of the neck; other two of the same kind surround the body, the one behind the fore legs and the other before the hind-legs. The hair on the rest of the body is gray, with some reddish spots, except that on the belly, which is white. The beard is gray and very long. The limbs, though long, are well proportioned.—*Kolbe's Descript.*]

THE GUIB, OR HARNESSED ANTILOPE.

THE harnessed antilope has strait horns, nine inches long pointing backward, with two spiral ribs. The ears are broad. The colour is a deep tawny. Beneath each eye there is a white spot. The sides are most singularly marked with two transverse bands of white, crossed by two others from the back to the belly; the rump with three white lines pointing downward on each side. The thighs are spotted with white. The tail is ten inches long, covered with long rough hairs.

This animal, though not taken notice of by any naturalist or traveller, is very common in Senegal, from which M. Adanson brought a skin of it, and presented it to the royal cabinet. It resembles the gazelles, and particularly the nanguer, in the size and figure of the body, in the lightness of the limbs, in the form of the head and muzzle, in the eyes and ears, and in the length of the tail, and the want of a beard. But all the gazelles, and especially the nanguers, have their bellies of a fine white colour; while the breast and belly of the guib are of a deep chesnut. It differs likewise from the gazelles by its horns, which are smooth, without transverse rings, and have two longitudinal ribs, the one

above and the other below, forming a spiral twist from the base to the point: they are also somewhat compressed. These characters make the guib approach the goat more than the gazelle. It is, however, neither the one nor the other but an intermediate species. This animal is remarkable for white bands upon a chesnut ground colour. These bands are disposed along and cross the body, like a harness. He lives in society, and great flocks of them are found in the plains and woods of the country of Podor.

THE GRIMM OR GUINEA ANTILOPE.

THE Guinea antilope has straight black horns, slender and sharp pointed, not three inches long, and slightly annulated at the base. The height of this most elegant animal is about eighteen inches. The ears are large, and the eyes dusky: below the eyes is a large cavity, into which exudes a strong scented oily liquid. Between the the horns is a tuft of black hairs. The colour of the neck and body is brown, mixed with cinereous and a tinge of yellow. The belly is white. The tail is short, white beneath, and black above.

This animal is known to the naturalists by the appellation of the *grimm goat* only, which, as we are ignorant of the name given it in its native country, we shall adopt. There is a figure of it in the German Ephemerides, which has been copied in the Academy Collection. Dr. Herman Grimm was the first who mentioned this animal; and what he says concerning it was copied by Mr. Ray, and afterwards by all the nomenclators.

[In a castle near the Cape of Good Hope, says Dr. Herman-Nicolas Grimm, I saw a very singular species of wild goat. It was of an obscure ash-colour. On the top of its head there was a tuft of erect hairs; and between each eye and nostrils a cavity filled with a yellowish humour, which was oily and viscid, and when exposed to the hair became black and hard; this substance, the odour of which participates both of castor and musk, renews successively after the cavities are emptied. I was assured that the cavities had no communication with the eyes, and that the thick humour they contained was different from that collected in the large angle of the eyes of stags and several other animals.]

Though this description be incomplete, he points out two characters so remarkable, that we easily recognised a head of a Senegal animal, sent us by M. Adanson, to belong to the grimm. The first is an enormous cavity below each eye, which penetrates so deep as to leave only a thin plate of bone between each cavity and the partition of the nose: the second is a bushy tuft of hair reflected backward on the top of the head. These characters sufficiently distinguish the grimm from all the other goats or gazelles. It has, however, a resemblance to both, not only in the form of the body, but even in the horns, which are annulated towards the base, furrowed longitudinally, like those of the gazelles, and at the same time directed horizontally backward, and very short, like those of the small African goat, formerly mentioned. Besides, this animal being much smaller than the goats, gazelles, &c. and having very short horns, seems to constitute the shade between the goats and the *chevrotains*, or small antilopes.

In the species of the grimm, the males alone appear to have horns; for the individual described and engraved by Dr. Grimm had no horns; and the head given us by M. Adanson had two short horns, nearly concealed among the hair, though still apparent enough to be seen by the drawer: besides, in the history of the *chevrotains*, or small antilopes, we will find, that in the royal or Guinea antilope, the male alone has horns; which makes it probable that the case is the same with the grimm species, which is more allied to the small antilopes than to any other animals.

SUPPLEMENT.

It is worthy of remark, that the horns of the grimm, preserved in the royal cabinet, bend a little forward at their points; while those described by Vosmaer and Pallas bend a little backward. The ears of the former are round at the extremities; but those of the latter terminate in a point. Is this a natural variety, or an error in the drawing? Vosmaer and Pallas's grimm has the point of the nose black, a black band extending from the nose along the chanfrin, and ending at the tuft of hair placed on the top of the front. The head in the royal cabinet has not this band. These slight differences, however, are not sufficient to constitute distinct species.

M. Vosmaer calls this animal the *small beautiful buck* of Guinea, probably on account of its elegance. But I shall retain the name of *grimm*; because under that appellation it is known to all the naturalists.

'This animal,' M. Vosmaer remarks, 'was a male,

'and one of the most beautiful and delicate creatures I 'ever saw. It was sent from Guinea to Holland along 'with thirteen others of the same species, and of both 'sexes. Twelve of them died during the voyage, and in 'this number were all the females; so that there re- 'mained alive two males only, which were put into the 'menagerie of the Prince of Orange, where one of them 'died in the winter of 1764. According to our information 'the females have no horns. These animals are extremely 'timid. Any noise, and particularly thunder, terrifies 'them. When surprised they express their fear by 'blowing suddenly and with great force through their 'nose.

'The one which is still alive (in 1766) was at first 'wild; but has now become pretty tame. It listens 'when called by its name *tetje*, and when gently ap- 'proached with a piece of bread in the hand, it allows 'its head and neck to be stroked. It is so cleanly that 'it suffers not the smallest particle of dirt to remain on 'any part of its body; for this purpose it often scratches 'itself with one of its hind feet. This is the reason 'why it has received the appellation of *tetje*, from *tettig*, 'which signifies *neat* or *clean*. However, if a person 'continues for some time to rub its body a white powder 'adheres to his fingers like that which proceeds from 'horses when they are curried.

'This animal is extremely agile; and when reposing 'it frequently keeps one of its fore feet in an elevated 'and bended position, which gives it a very agreeable 'appearance. It is fed with bread, rye, and carrots: it 'likewise spontaneously eats potatoes. It is a ruminat- 'ing animal, and discharges its excrements in small 'balls, the size of which is considerable in proportion 'to the magnitude of the creature.'

Dr. Herman Grimm tells us, that the fat, viscera, yellow humour, which is secreted in the cavities above the eyes of this animal, has an odour that participates of musk and castoreum. M. Vosmaer remarks, that in his live subject this viscid matter had no odour of any kind; and that the figure given by Grimm is extremely erroneous; for it represents a tuft of hair on the forehead, which has no existence; and his subject, which was a female, had no horns: 'But ours,' continues M. Vos- maer, 'is a male, and has large horns in proportion to 'its size: and instead of this high erect tuft of hair, it 'had only a small quantity, which rose a little to a point 'between the horns. It is about the size of a kid of two 'months old;' (though it was probably three or four years of age; because it was sent from Guinea before the winter 1764, and M. Vosmaer published his descrip- tion of it in the year 1767.) 'Its limbs are fine, and 'well proportioned to its body. Its head is beautiful, 'and pretty much resembles that of a roebuck. The 'eye is lively and full of fire. The nose is black and 'naked, but always moist. The nostrils are shaped like 'a long crescent. The edges of the muzzle are black. 'The upper lip, though not divided, has the appearance 'of being separated into two lobes. There is no hair 'on the chin; but a little higher there are on each side 'a kind of small whiskers; and under the throat a sort 'of wart garnished with hair,' (which brings this animal still nearer to the goat kind, most of whom have similar warts or exerescences on their throats.)

'The tongue is rather round than oblong or pointed. 'The horns are black, finely furrowed from top to bot- 'tom, and about three inches in length: they are per- 'fectly straight, and terminate in a very sharp point. 'At the base they are nearly three quarters of an inch 'thick; and they are ornamented with three rings which 'rise a little backward.

'The hairs on the front are straighter than the others; 'and at the origin of the horns they are coarse, gray, 'and crisped. Between the horns the hair is more erect, 'and forms a kind of pointed black tuft, from which a 'stripe of the same colour descends and loses itself in 'the nose.

'The ears are large, and have on the outside three 'cavities or depressions, directed from the top to the 'bottom. Internally, and at the summit, the ears are 'garnished with white short hair: the rest of the ears 'are naked and black. The eyes are pretty large, and of 'a deep brown colour. The hair on the eye-lids is black, 'close, and long, especially on the upper eye-lid. Above 'the eyes there are some long hairs; but they are 'thinly dispersed.

'On both sides, between the eyes and nose, we see 'those remarkable cavities by which this animal is 'easily distinguished. These parts are naked and black. 'In the middle a cavity or depression appears, which 'is somewhat callous, and always moist. A small 'quantity of a viscid gummy humour distills from it, 'which soon hardens and becomes black. The ani- 'mal seems occasionally to throw off this excremen- 'titious matter; for we find it hard and black, on 'the stakes of his lodge, as if it had been wiped off. 'With regard to the odour mentioned by Dr. Grimm 'and his followers I could never discover it.

'The under part of the neck, which is moderately 'long, is covered with pretty coarse hair, of a yellowish 'gray colour, like that of the head. But the throat and 'upper part of the neck is white.

'The hair on the body is black and stiff, though it be 'soft to the touch. That on the anterior parts is of a 'fine bright gray colour; farther back it is a bright 'brown; toward the belly it is gray; and lower down 'it is perfectly white.

'The legs are extremely slender, and blackish near 'the hoofs. The anterior parts of the fore feet, as far 'as the knees, are adorned with a black band. They 'have no heels; but in their place there is a slight

'excrescence. The feet are cloven, and provided with 'beautiful, black, pointed, smooth hoofs.

'The tail is very short, white, and marked above 'with a black band. With regard to the organs of 'generation, they are firmly inclosed in a black scrotum, 'hang down between the legs, and are provided with a 'large prepuce.

THE CHEVROTAINS, OR SMALL ANTILOPES.

THE name *chevrotain (tragulus)* has been applied to those small animals of the warm regions of Africa and Asia, which are mentioned by almost every traveller under the denomination of the *small stag*, or the *small hind*. They, indeed, resemble the stag in the figure of the muzzle, in lightness of body, in the form of the limbs, and in the shortness of the tail. But they differ from him prodigiously in size, the largest not exceeding the magnitude of a hare. Besides, some of them want horns entirely; and, in those which have horns, they are hollow, annulated, and pretty similar to those of the gazelles. Their small cloven foot has also a greater resemblance to the foot of the gazelle than to that of the stag; and their want of pits, or depressions under the eyes, removes them equally from the gazelles and the stags. In this article they approach the goats: but, in fact, they are neither stags, gazelles, nor goats, but constitute one or several distinct species. Seba gives a description and figures of five chevrotains. The first he calls *the small African hind from Guinea, which is reddish, and without horns;* the second, *the fawn or young stag of Africa, which is very delicate;* the third, *the young, very small stag of Guinea;* the fourth, *the small hind of Surinam, which is reddish, and marked with small spots;* the fifth, *the African stag, with reddish hair.* Of these five *chevrotains*, the first, second, and third, are evidently the same animal. The fifth, which is larger than the three first, and whose hair is much longer, and of a deeper yellow colour, seems to be only a variety of the first kind. The fourth, which Seba mentions as a native of Surinam, appears to be a second variety of this species, which is found in Africa, but not in the southern regions of Asia; and I am inclined to think, that Seba has been ill informed, when he tells us, that this animal came from Surinam. All voyagers mention these small stags or chevrotains as being found in Senegal, Guinea, and the East-Indies; but no traveller affirms that he has seen them in America. If Seba's spotted chevrotain really came from Surinam, we must presume that it had been transported from Guinea, or some other southern region of the Old World. But there seems to be a second species of chevrotain, different from all those we have mentioned, which are only simple varieties of the first. This second species has horns, which are only an inch in length, and as much in circumference. These small horns are hollow, black, a little bended, very sharp at the points, and surrounded at the base with three or four transverse rings. In the king's cabinet, we have the feet of this animal, and one of its horns; and these parts demonstrate, that it is either a chevrotain, or a very minute gazelle. Kolbe, when mentioning this species, says, that its horns were similar to those of the stag, and that they have branches in proportion to their age. This is an evident blunder, as appears from a bare inspection of the horns themselves.

[In Congo, Viga, Guinea, and other places near the Cape of Good Hope, we find a species of goat which I call the *Congo goat.* It is not larger than a hare; but its beauty and symmetry are truly admirable. Its horns resemble those of the stag, and have also branches in proportion to their age. Its legs are very handsome, and so small, that the inferior part of them is often used as a tobacco stopper. They are mounted with gold or silver.—*Kolbe's Descript.*]

The figure of these animals is elegant, and their members are finely proportioned to their size. They make prodigious bounds; but it is probable that they cannot run long; for the Indians overtake them in the chase. The indians hunt these animals, and kill them with sticks or small darts. They are in great request, on account of the delicacy of their flesh.

By comparing the relations of voyagers, it appears, 1. That the chevrotain, whose figure we have given, and who wants the horns, is peculiar to the East-Indies; 2. That the one with horns is the chevrotain of Senegal, called *guevei* by the natives; 3. That the male *guevei* has horns, and that the female has none; 4. That the chevrotain, spotted with white, and which Seba says is brought from Surinam, is, on the contrary, a native of the East Indies, and particularly of Ceylon, where it is called *memina.* We must, therefore, conclude, that there are only two known species of chevrotains, the memina, or Indian kind, without horns, and the guevei or chevrotain of Guinea, with horns; that the five

species of Seba are only varieties of the memina; and that the smallest kind, called *guevei-kaior* in Senegal, is only a variety of the guevei.

[The royal antilope has very short, strait horns, black and shining as jet, and scarce two inches long. The ears are broad; and the height not above nine inches. The legs are not thicker than a goose quill. The colour is a reddish brown. The females want horns.—*Pennant.*

In the kingdom of Acara, on the Gold Coast, we find hinds so small that they exceed not eight or nine inches in height. Their legs are not thicker than a goose quill. The males have horns, which bend back on the neck, and are two or three inches long. They have no branches or antlers, but are twisted, and as black and shining as jet. These small animals are very tame, fawning, and caressing; but they are so extremely delicate, that no attempts to transport them into Europe have ever succeeded.—*Voyage de Desmarchais.*]

None of these small animals can subsist, except in very warm climates. They are so extremely delicate, that it is with the utmost difficulty they can be transported alive into Europe, where they soon perish. They are gentle, familiar, and most beautifully shaped. Beyond all comparison, they are the smallest cloven-footed animals. From this last character, they should produce but few young at a litter. From their minuteness, on the contrary, they ought to bring forth a great number. On this subject, we must wait for information from those who have an opportunity of observing their œconomy. We imagine that they bring forth but one or two at a time, like the gazelles, roe-deer, &c. But perhaps they produce more frequently; for they are very numerous in India, Java, Ceylon, Senegal, Congo, and in all the very warm countries; and none of them are found in America, or in any of the temperate regions of the Old Continent.

THE MAZAMES.

MAZAME, in the language of Mexico, was the name of the *stag*, or rather a generic name including the *stag*, the *fallow deer*, and the *roebuck*. Hernandes, Recchi, and Fernandes, who furnished us with this appellation, distinguish two species of mazames, both of which are very common in Mexico and New Spain. The first, and the largest, to which they give the simple name of *mazame*, has horns resembling those of the European roebuck, that is, about six or seven inches long, with the extremities divided into two points, and a single antler. The second, which they call *temamacame*, is smaller, and its horns are simple, and have no antlers. These two animals appear to be really roebucks, the first being the same species with the European roebuck, and the second only a variety of it. It likewise appears, that these roebucks, or mazames and temamacames of Mexico, are the same with the *cuguacu-apara* and the *cuguacu-ete* of Brasil; and that, at Cayenne, the first is called *cariacou*, or *wood hind*, and the second the *small cariacou*, or *savannah hind*.

[The figure of Piso's *cuguacu-ete*, has a perfect resemblance to our roebuck; and we have only to compare it with that of Recchi's mazame, to be satisfied that it is the same animal. This cuguacu-ete of Piso has palmated horns; yet Marcgraave, though he has given no figure, tells us, that it has no horns, and that it is the *cuguacu-apara*, which has horns with three antlers. As in the roe-deer, the female has no horns, it is probable, that the individual pointed out by Marcgraave was the female. The descriptions given of these animals by Piso and Marcgraave demonstrate that they are roebucks, perfectly similar to those of Europe.]

Though we have first exhibited these relations, yet we would not have presumed that every difficulty or doubt was removed, if Seba had not given, under the denominations of *mazame* and *tamamacame*, two different animals: they are not roebucks with horns solid and palmated, but gazelles with hollow and twisted horns. They are not natives of New Spain, as this author affirms, but of Africa. These blunders of Seba have been adopted by most subsequent naturalists. They never doubted but that the animals mentioned by Seba, under the names of *mezame* and *temamacame*, were American animals, and the same with those taken notice of by Hernandes, Recchi, and Fernandes. The confusion of the names has given rise to a confusion of the animals themselves; and, of course, some naturalists have pointed them out under the name of *chevrotains*, and others under that of *gazelles*, or *goats*. Linnæus seems to have been aware of this error; for he has not copied it. He has placed the mazame among the list of stags, and he has thought, as we do, that the Mexican mazame is the same animal with the cuguacu of Brasil.

To demonstrate what we have advanced, let us suppose,

that there are neither gazelles nor chevrotains in New Spain, or in any other part of America; that there were no goats or gazelles in the New World before it was discovered, but that all those which are now there were transported thither from the Old Continent; that the true mazame of Mexico is the same animal with the Brasilian cuguacu-apara; that the name *cuguacu* is pronounced *couguacou;* and that by a corruption this animal was called *cariacou* in Cayenne, from which it was transmitted to us alive under the denomination of cariacou. We shall now endeavour to investigate the species of the two animals to which Seba has falsely applied the names mazame and temamacame; for to destroy an error it is not enough to reject it, but its cause and effects must also be exhibited.

The gazelles and chevrotains inhabit only the warmest countries of the Old World. They cannot subsist in temperate, and far less in cold climates. Hence they could never frequent the northern regions, nor pass by means of these regions from the one continent to the other. No travellers, accordingly, or historians of the New World, ever pretend to have seen gazelles or chevrotains in that quarter of the globe. The stag and roebuck, on the contrary, are natives of cold and temperate climates. They might therefore pass by means of the northern lands, and, accordingly they are found in both continents. In the history of the stag it was shown that the Canadian stag is the same with the European; and that he is only smaller, and has some trifling variations in the figure of his horns and the colour of his hair. We may add to what was then related, that there are as many varieties among the American as among the European stags; and yet they are all of the same species. It is smaller and browner than the common kind. We have also mentioned white stags and hinds, and have attributed this colour to their domestic state: this kind is likewise found in America, as well as our common and small brown stags. The Mexicans, who reared these white stags in their parks, called them *royal stags.* It is a native of Germany, commonly called the *stag of Ardennes* and *brandhirts* by the Germans. It is fully as large as the French stags, from which it differs by some remarkable characters. Its hair is more bushy, and lighter under the belly; and like the he-goat it has long hairs upon its neck and throat, which induced both the ancients and moderns to give it the appellation of *tragelaphus* or *goat-hart.* The roebucks are likewise very numerous in America. In Europe we know only two varieties, the red and the brown. The latter are smaller than the former; but in other respects they perfectly resemble each other, and both have palmated horns. The mazame of Mexico, the cuguacu-apara of Brasil, and the cariacou, or wood-hind, of Cayenne, have an entire resemblance to our red roebucks. To be convinced that all these names denote the same animal, we have only to compare the descriptions given under them. But the temamacame, which in our opinion is the cuagucu-été of Brasil, the small cariacou or Savannah hind of Cayenne, may be only a variety different from those of Europe. The temamacame is smaller, and has also a whiter belly than the mazame, in the same manner as our brown roebuck is smaller, and has a whiter belly than the red kind. It appears likewise to differ from the mazame in its horns, which are simple and without antlers in the figure given by Recchi. But if it be considered, that in our roebucks and stags the horns have no antlers during the first and sometimes the second year of their age, we will be led to believe, that Recchi's temamacame was too young to have antlers. Hence these two animals seem to be only varieties of the roebuck species, which will be still farther apparent from comparing the figures and descriptions of the different authors we have quoted with the figure here given of a cariacou which was sent us from Cayenne, and which we nourished in Burgundy for several years.

It now remains to investigate the two animals exhibited by Seba under the false appellations of *mazame* and *temamacame.* The bare inspection of the figures, independent of his description, which we have inserted above in the notes, show that these animals belong to the goats or gazelles, and by no means to the stags or roebucks. The want of a beard, and the figure of the horns, prove that they are not goats but gazelles; and by comparing Seba's figures with the gazelles I have described, I discovered that his pretended *temamacame of New Spain* is the *kob,* or *small brown cow of Senegal.* The figure, colour, and size of the horns are the same. The colour of the hair, which differs from other gazelles by being yellow, instead of white, on the belly and flanks, is also the same. With regard to his pretended *mazame,* though it has a general resemblance to the gazelles, it differs remarkably from all those we have formerly enumerated. But we have found in the cabinet of M. Adanson, which contains the rarest productions of Senegal, a stuffed animal, which we called *nagor,* on account of the resemblance of its horns to those of the nanguer. This animal is found in the lands adjacent to the island of Goree, from which it was transmitted to M. Adanson by M. Andriot, and possesses all the characters which Seba has attributed to his pretended *mazame.* The whole body is of a pale red colour; and the belly is not white as in other gazelles. It is as large as a roebuck. Its horns, which exceed not six inches in length, are almost smooth, slightly bended in a forward direction, but not so much as those of the nanguer. Hence this animal, exhibited by Seba under the name of *mazame* or *American stag,* is, on the contrary, an *African goat* or *gazelle,* which we add here, under the appellation of *nagor,* to the twelve gazelles whose history we have formerly given.

[The red antilope, with horns five inches and a half long, and one or two slight rings at the base. The length of this animal is four feet, and the height two feet three inches. The ears are five inches long. The hairs are stiff and bright. All parts of the body are of a reddish colour.—*Pennant.*]

THE COUDOUS, OR INDIAN ANTILOPE.

THE Indian antilope, with thick straight horns, marked with two prominent spiral ribs near two-thirds of their length, and smooth towards their end: some are above two feet long. Those at the British Museum, with part of the skin adhering, are black. The colour of the hair on the fragment of the head is of a reddish brown, bounded on the cheeks by a dusky line beneath, of a pale brown.

The class of ruminating quadrupeds is the most numerous and the most diversified. It comprehends, as we have seen, a great number of species, and perhaps a still greater number of distinct races or permanent varieties. Notwithstanding all our researches, and the laborious details into which we have been obliged to enter, we freely acknowledge that the subject is by means exhausted, and that there still remain animals of considerable note which we know only by imperfect fragments, and are unable to ascertain the creatures to which they belong. For example, in the very large collection of horns preserved in the royal cabinet, as well as in private museums, each of which, after much labour and investigation, we have referred to the animal to whom it belongs, except one, which having neither ticket nor any other artificial mark of information, is absolutely unknown. This horn is very large, almost straight, and composed of a thick black substance. It is not solid like that of the stag; but it is a hollow horn, filled with a bone or core, like the horns of oxen. A thick rib, raised about an inch, runs from the base to above the middle of the horn. Though the horn be straight this prominent rib makes a spiral turn and a half in the inferior part, and is entirely effaced in the superior part, which terminates in a point. Upon the whole this horn seems to have a greater relation to those of the buffalo than to any other. But we are ignorant of the name of the animal; and it was not till lately, that in searching different cabinets, we found in that of M. Duplex a fragment of a head with two similar horns, to which the following ticket was affixed: 'Horns of an animal some-'what like a horse, of a grayish colour, with a mane on 'the fore part of the head like a horse. It is called here '(at Pondicherry) coesdoes, which should be pronounced '*coudous*.' This small discovery gave us great joy. We could not, however, find the name *coesdoes* or coudous in the writings of any voyager. We learned from the ticket alone, that this animal is very large, and that he is a native of the warmest countries of Asia. The buffalo belongs to the same climate, and has also a mane on the top of his head. His horns, it is true, are crooked and flat, while those under consideration are round and straight, which, as well as the colour, sufficiently distinguishes these two animals; for the skin and the hair of the buffalo are black, and according to the ticket the hair of the coudous is grayish. These relations suggested others: the travellers into Asia mention large buffaloes of Bengal, reddish buffaloes, and grayish buffaloes of the Mogul empire, called *nil-gauts*. The coudous is perhaps one or other of these animals. From the travellers into Africa, where the buffaloes are as common as in Asia, we have more pointed information with regard to a species of buffalo called *pacasse* in Congo, which seems to be the coudous: 'Upon the route from Louanda to the 'kingdom of Congo we perceived two pacasses, which 'are animals resembling buffaloes, and roar like lions. 'The male and female go always in company. They 'are white, with red and black spots. Their ears are 'half an ell long, and their *horns are entirely straight*. 'When they see any person they neither fly nor do any 'harm, but stare at the passengers.' We formerly remarked, that the animal called empacassa, or pacassa, in Congo, appeared to be the buffalo. It is, in fact, a species of buffalo, differing from him only in the figure of the horns and colour of the hair. In a word, the pacassa is the coudous, which perhaps constitutes a different species from that of the buffalo, and perhaps is only a variety of it.

[The country of Congo produces an animal which the natives call *empacassa*. Some people think it is the buffalo, and others that it has only a great resemblance to that animal. The editor of Lopes's Account tells us, that it is not so large as a buffalo, but that it resembles him in the head and neck. Dapper assures us, that the buffalo is called *empacassa* in the kingdom of *Congo*, and that its hair is red, and its horns black.—*Hist. Gen. des Voyages.*]

THE MUSK.

THE Tibet musk is of the form of a roebuck: length three feet three inches; from the top of the shoulders to the soles of the feet, two feet three inches. The upper jaw is much longer than the lower; on each side of which there is a slender tusk, near two inches long, hanging out quite exposed to view. In the lower jaw are eight small cutting teeth, none in the upper, and in each jaw six grinders. The ears are long and narrow, the inside of a pale yellow, the outside deep brown. The chin is yellow. The hair on the whole body is erect, very long, and each marked with short waves from top to bottom. The colour near the lower part is cinereous, black near the end, and ferruginous at the tips. The hoofs are slender and black; and the spurious hoofs of the fore-feet are very long. The tail is an inch long, hid in the hair. The scrotum is of a bright red colour; but the penis is so hid as scarce to be discovered. The female is less than the male, and her nose sharper. She wants the two tusks, and has two small teats. The noted drug the musk is found in a bag or tumour, of the size of a hen's egg, on the belly of the male only. —*Pennant.*

To finish the history of the goats, gazelles, chevrotains, and other animals, of this kind, which are all natives of the Old Continent, it now only remains to give that of the musk, an animal as famous as it is little known. It has been mentioned by all our modern naturalists, and by most travellers into Asia. Some of them have considered it as a *stag*, a *roebuck*, or a *musk goat*, and others as a large *chevrotain*. It seems, indeed, to be an ambiguous animal, participating of the nature of all these species. We may be assured, however, that its species is distinct, and different from all the other quadrupeds. It is of the size of a small roebuck; but has no horns. By this character, it resembles the *memina* or Indian musk. It has two large tusks in the upper jaw, by which it approaches to the Guinea musk. But, what distinguishes the musk from all other animals, is a kind of bag near its navel, about two or three inches in diameter, in which the liquor, or rather fat humour, called *musk*, is secreted, and which differs both in odour and consistence from that of the civet. Neither the Greeks nor Romans mention this animal. It was first taken notice of by the Arabians. Gessner, Aldrovandus, Kircher, and Boym have treated pretty fully of this animal; but Grew is the only author who has given an exact description of it from a stuffed skin, which, in his time, was preserved in the cabinet of the royal society of London.

[Abusseid Serasi remarks, that the musk animal resembles the roebuck in the skin and colour, in the slenderness of the legs, in the hoofs, in the *erect and somewhat bended horns;* and that it is armed with two white tusks on the side of each cheek. This author alone asserts, that the musk animal has horns; he has perhaps conjectured from analogy, that as it resembled the roebuck in other respects, it ought likewise to have horns. We have taken notice of this error, because it is copied by Aldrovandus. Avicenna, when speaking of the *musk*, says, that it is the purse or follicle of an animal pretty similar to the roebuck, only it has two large crooked tusks. There is a figure of this animal in the fragment of Cosmas, printed in the first volume of Tavernier's travels.

'I say, in the first place, that there is a certain stag in the provinces of Xensi and Chiamsi, which has a fine odour, and is called by the Chinese *xerchiam*, that is, the *musk animal*. The Chinese Atlas mentions it in the following terms: "To keep you no longer in suspense concerning the signification of the word *muschus*, I can assure you that I have seen the animal oftener than once. It has a protuberance near the navel which resembles a small purse, because it is surrounded with a very delicate skin, and covered with soft hair. The Chinese call this animal *xe*, which signifies *odour*, and the compound word *xehiang* denotes the odour of the animal *xe*, or *se*, muschus." It is four feet long, and as swift as a stag. The only difference is, that its hair is blacker, and it has no horns. The Chinese eat its flesh, which is very delicate. The provinces of Suchuen and Junnan abound with these animals, and they are most numerous in the western provinces of China.'—*Kircher.*

'The musk deer breeds in China and the East Indies. Not ill pictured in Calceolarius's museum. That in Kircher's *China illustrata* faulty as to the snout and feet. That of Jonston absurd. Almost every where worse described. That he is a two horned animal, says Aldrovandus, all agree, except Simeon Sethi, who saith he hath but one. Neither of which is true. The description likewise given by Scaliger, and out of him by Chioeco in Calceolarius's museum, is false, and very defective. The best I find is amongst the German Transactions; to which I would have referred the reader, but that, comparing it with that I had drawn up before I met with it, I see some differences.

'From his nose to his tail, a yard and half a foot long. His head above half a foot. His neck one-fourth of a yard. His fore-head three inches broad. His nose-end

scarce three-fourths of an inch, being very sharp, like that of a greyhound. His ears like a coney's, about three inches long, and erect. As also his tail or scut, which exceeds not two inches. His fore legs a foot and two inches long, taking in foot and thigh. Near an inch over; the foot deeply cloven; with two fore hoofs, an inch and a quarter long, each a quarter of an inch over; and two heels almost as big, and therefore conspicuous. His hinder feet are here wanting.

'His hair on his head and legs about half an inch long, and rateably small. On his belly, an inch and a half long, and somewhat thicker. On his back and buttocks three inches long, thicker in proportion than any other animal, except perhaps some of the deer kind, *viz.* three or four times as thick as hog bristles; consisting of brown and white portions alternately from the root to the top. On the head and legs brown. On the belly and under the scut, whitish. As it were frizzled, especially on the back and belly, by a kind of undulation. Softer than in most animals, and exceeding light and rare. For, being split and covered with a gloss, they appear to be made up of little bladders, like those in the plume or stalk of a quill; so that it is a thing betwixt a common hair and a quill. On each side his lower chop, almost under the corner of his mouth, there is a peculiar tuft, (about three fourths of an inch long,) of short, thick, and hard hairs, or rather bristles, of equal length, as in a scrubbing brush.

'The musk bladder or bag is about three inches long, two over, and swelling out from his belly one and a half. Standing before his groin about as much. I find it cut open, whereby the observation of its natural aperture (which I suppose it hath as the castor bag) is prevented.

'He hath twenty-six teeth. In his lower chop, sixteen; of which there are eight little cutters before; behind four grinders on each side, rugged and continuous. As many like grinders in the upper jaw. About an inch and a half from the nose-end, in the same jaw, on each side a tusk, two inches and a half long, hooked downward, and backward, and ending in a point. Not round, but flat, the breadth of half an inch; thin, and having a sharp edge behind; so as it may not unfitly be likened to a sithe. There are no horns.'—*Grew.*]

The year after the publication of Grew's work, in 1681, Luc Schrokius printed, at Vienna, the history of this animal, which contains nothing remarkable either for correctness or novelty. [Schrokius gives a figure, but no description of this animal. He only remarks, that it resembles a roebuck, with the exception of having two prominent tusks in the upper jaw, about three inches long, and directed downward; that this is the chief characteristic of the animal; that it varies in the colour of its hair; that its head likewise differs from the roebuck, and approaches to that of the wolf; that the hair is generally marked with several spots; and that the protuberance which contains the *musk* is situated a little below the navel. He adds, that this animal is found in Tartary, in Tibet, in China, and particularly in the province of Xinsi, in Tonquin, in Pegu, in the kingdom of Aracan, and in Boutain.]

I shall, however, combine the facts which can be gathered from this description with those of other authors, and particularly the more modern travellers. Having never been able to procure the animal itself, we are reduced to the necessity of collecting and digesting what has been said of it by others. From Grew's description, which is the only authentic work we are possessed of, it appears that this animal has long coarse hair, a sharp muzzle, and tusks like those of a hog; and that, by these characters, it approaches the wild boar, or rather the *babiroussa*, called the *wild Indian boar* by the naturalists, which, along with several characters of the hog, is, like the musk animal, smaller, and has taller and more nimble limbs, resembling those of the stag or roebuck. On the other hand, the American hog, which we have called *pecari*, has on his back a cavity or purse which contains an odoriferous humour; and the musk animal has a similar purse, not on his back, but under his belly. In general, none of those animals which produce odorous liquors, as the badger, the beaver, the pecari, the musk rats, and the civet, belong to the genus of deer or goats. Hence we should be led to think, that the musk animal makes a nearer approach to the hog kind, of which he has the tusks, if, at the same time he had cutting teeth in the upper jaw. But, his want of these teeth connects him with the ruminating animals, and particularly with the chevrotain, which chews the cud, though it has no horns. All these external characters, however, furnish us with conjectures only. But an examination of the internal parts can alone decide concerning the nature of this animal, which is still very little known. I have made it follow the goats and antilopes, not because it seems to have any connection with these species, but lest I should too much offend the prejudices of most naturalists.

Marco Paolo, Barbosa, and P. Philippe de Marini, are all more or less deceived in the notices they have given concerning this animal. The only fact in which they agree is, that the *musk* is formed in a pouch or tumour near the navel; and it appears from their testimonies, as well as those of other travellers, that the male alone produces the *musk*; that the female has the same pouch near the navel, but that the humour secreted in it has not the same odour; that this tumour of the male is not filled with *musk*, except in the rutting season; and that, at other times, the quantity of this humour is smaller, and its odour weaker.

With regard to the *musk* itself, its essence is perhaps as little known as the nature of the animal from which it is procured. All travellers agree, that this substance

is perpetually adulterated with blood or other drugs by the venders. The Chinese not only augment its size by mixture, but they endeavour to increase its weight by incorporating with it finely powdered lead. The *musk* that is purest, and in most request among the Chinese themselves, is that which drops spontaneously from the animal upon stones or trunks of trees, against which it rubs when the matter is too abundant, or begins to irritate the pouch where it is formed: that found in the pouch itself is seldom so good, because it is not fully ripe, or rather because it is during the rutting season only that it acquires its greatest strength and odour; and at this period the animal endeavours to get rid of a matter which is too highly exalted, and occasions itching and some degree of pain. Both Chardin and Tavernier have well described the methods practised by the orientals to adulterate *musk*. The merchants must necessarily augment the quantity of it beyond conception; for in one year Tavernier purchased 1663 bags, which supposes an equal number of animals. But as this animal is no where domestic, and the species confined to a few provinces of the East, it cannot possibly be so numerous as to produce such a quantity of this matter. Most of these pretended bags, therefore, must be little artificial bladders made of the skin of other parts of the animal's body, and filled with blood and small portions of the true *musk*. It affords, in fact, the strongest of all known odours. A small bit of it perfumes a large quantity of matter. The odour of a small particle extends through a considerable space. It is likewise so fixed and permanent, that at the end of several years it seems to have lost no part of its activity.

[It is well known that *musk* is the excrementitious matter of an animal which resembles the wild goat, except that its limbs and body are more delicate. It is found in High Tartary, in the north of China, and in Tibet, which is a kingdom between India and China. I never saw these animals alive, but I have seen their skins in many places. There are figures of them in the Dutch ambassador's lodgings at China, and in the *China illustrata* of Kircher. It is commonly said, that the *musk* is the sweat of the animal, which runs down and is collected in a thin bladder near the navel. But the natives of the East tell us with more precision, that it is formed in an abscess within the body, and near the navel of this goat, the humour of which produces an itching and prickling pain, especially when the animal is in season; that by rubbing against trees or rocks the abscess bursts, and the matter is diffused between the muscles and the skin, where it collects and forms a kind of blister or bladder; and that the internal heat exalts this corrupted blood, and gives it the strong odour of *musk*. This bladder is called *the navel of the musk*, or *the odoriferous navel*. The eastern people prefer the Tibet *musk* to that of China, whether it is really a stronger odour or only appears so, because it arrives to them fresher, Tibet being nearer to them than the province of Xinsi, which produces more *musk* than any other district of China. The great musk trade is carried on at Boutan, a celebrated town in the kingdom of Tibet. The Patans go there to purchase it; and they distribute it over all India, from whence it is transported through the whole earth. The Patans border on Persia and High Tartary, and are subject or rather tributary to the Great Mogul. The Indians make great use of this aromatic drug. They employ it in their perfumes, confections, and every composition they have been accustomed to prepare for the purposes of provoking love or of restoring lost vigour. It is commonly alledged, that when the musk bag is cut open, so strong an odour bursts out that the hunter is obliged to have his mouth and nose covered with several folds of linen; and that, notwithstanding this precaution, the force of the odour is often so great as to produce a mortal hæmorrhagy. I made a particular inquiry into this fact, and having heard similar accounts from some Armenians who had been at Boutan, I am inclined to think it is true; because this drug, instead of acquiring, loses its odour in process of time. Now this odour is so strong in India, that I was unable to bear it. When I dealt in musk I stood always in the open air with a handkerchief on my face, and at a distance from those who handled the bladders and brought them to my broker. I then perceived that musk when fresh is extremely heady, and quite insupportable. I shall only add, that there is no drug so easily or so frequently adulterated. Some bags are only pieces of the animal's skin filled with its blood, and a small quantity of musk to give it an odour, instead of that bladder formed by the wisdom of nature near the navel to receive this wonderful and odoriferous humour. With regard to the genuine bladders, when the hunters find that they are not full they squeeze the animal's belly and fill them with blood; for they believe that the blood of the musk, and even its flesh, has a fine scent. The merchants afterwards mix the musk with lead, ox's blood, and other substances proper for augmenting its weight. The eastern people employ several modes of detecting this falsification without opening the bag; they learn from experience to distinguish the proper weight of an unadulterated bag. They likewise know by the taste. Hence the Indians never purchase musk without tasting small grains of it, which they squeeze out of the bags. In fine they take a thread steeped in garlick juice, and draw it through the bag with a needle: if the odour of the garlick be extinguished the musk is good, and if the thread preserves the scent of the garlick the musk is adulterated.—*Chardin.*

The best and the greatest quantities of musk come

from the kingdom of Boutan, from which it is carried for sale to Patna, the chief town of Bengal. All the musk sold in Persia is transported from thence. I had the curiosity to carry a skin of this animal to Paris, and have given a figure of it.

After killing the animal the peasants cut off the bag; which is of the size of an egg, and is situated nearer the organs of generation than the navel. They next take out the musk, which then has the appearance of clotted blood. When they want to adulterate it, they put a mash of the animal's liver and blood in the place of the musk they had extracted. In two or three years this mixture produces certain small animals which eat the good musk; so that when opened a great defalcation is discovered. Others, after extracting a portion of the musk, put in small pieces of lead to augment the weight. The merchants who transport musk to foreign countries love this trick better than the other; because none of these small animals are produced by it. But the deceit is still worse to discover, when of the skin taken from the belly of a young animal they make little bags, which they sew so dexterously with threads of the same skin that they resemble genuine bags. These they fill with what they take out of the genuine bags, and some fraudulent mixture, which it is extremely difficult for the merchants to detect. When the bags are sewed immediately upon their being cut, without allowing any part of the odour to dissipate in the air; after they have abstracted as much of the musk as they think proper, if a person applies one of these bags to his nose, blood will be drawn by the mere force of the odour, which must necessarily be weakened or diluted in order to render it agreeable without injuring the brain. The odour of the animal I brought to Paris was so strong that it was impossible to keep it in my chamber. It made every head in the house giddy; and I was obliged to put it in a barn, where my servants at last cut away the bag: the skin, notwithstanding, always retained a portion of the odour. These animals are not found in a lower latitude than the fifty-sixth degree. But in the sixtieth they are very numerous, the country being full of woods. In the months of February and March, it is true, after suffering much hunger in their favourite clime on account of the snow, which is sometimes ten or twelve feet deep, they come southward as far as the forty-fourth or forty-fifth degree, in order to procure grain or fresh rice. During this period the peasants lie in wait for these animals with snares, and kill them with arrows and bludgeons. Some of them, I was assured, are so meagre and languishing with the hunger they suffer that they are easily taken. These animals must be extremely numerous; for each of them has but one bag, and the largest bag, which seldom exceeds the size of a hen's egg, cannot furnish above half an ounce of musk: three or four of them are sometimes necessary to afford a single ounce.

The king of Dantan, apprehensive that the practice of adulterating the musk would injure the commerce of his kingdom, especially as it is also produced, though dearer and in less quality, in Tonquin and Cochinchina, ordered some time ago that none of the bags should be sewed, but that the whole of them should be brought open to Boutan, the place of his residence, to be examined and sealed with his own seal. All those I purchased were of this kind. But notwithstanding all the precautions of the king the peasants opened the bags in a crafty manner, and put into them small pieces of lead, which the merchants tolerate, because lead, as formerly remarked, does not spoil the musk, but only augments the weight. In one of my voyages to Patna I purchased 1663 bags, which weighed 2557 ounces and a half; and the musk, when taken out of the bags, weighed 452 ounces.—*Tavernier.*

THE BABIROUSSA, OR INDIAN HOG.

THE Indian hog has four cutting teeth in the upper, six in the lower, and ten grinders in each jaw. In the lower jaw there are two tusks pointing towards the eyes, and standing near eight inches out of their sockets. From two sockets on the outside of the upper jaw there are two other tusks, twelve inches long, bending like horns, their ends almost touching the forehead. The ears are small, erect, and sharp pointed. Along the back are some small bristles. On the rest of the body only a sort of wool, such as is on lambs. The tail is long, ends in a tuft, and is often twisted. The body is plump and square, not of that elegant form which Bontius and Nieuhoff give it, as appears from an original drawing Mr. Loten favoured me with.—*Pennant.*

Though we have only the head of this animal in the royal cabinet, it is too remarkable to be passed over in silence. All naturalists have regarded it as a species of hog; and yet it has neither the head, the stature, the bristles, nor the tail of a hog. Its legs are longer, and its muzzle shorter. It is covered with short hair, as soft as wool, and its tail terminates in a tuft. Its body, likewise, is neither so heavy nor so thick as that of the

hog. Its hair is gray, mixed with red and a little black. Its ears are short and pointed. But the most remarkable character, which distinguishes the babiroussa from all other animals, consists in four large tusks or canine teeth, the two shortest of which proceed, like those of the wild boar, from the under jaw, and the two longest, by piercing the cheeks, or rather the lips, from the upper jaw, and extend in a curve above the eyes. These tusks are a beautiful ivory, which is cleaner and finer but not so hard as that of the elephant.

The direction of the two superior tusks, which first rise high, and then bend in the form of a circle, induced some able natural philosophers, such as Grew, to think, that these tusks ought not to be regarded as teeth but as horns. They founded their opinion upon this circumstance, that in all animals the sockets of the teeth in the upper jaw open downward; that in the babiroussa all the sockets likewise open downward, except those of the two great tusks, which open upward; and hence they conclude, that from this essential character of the upper teeth, these tusks, whose sockets open upward, cannot be regarded as teeth but as horns. These philosophers, however, were deceived. Position or direction are circumstances by no means essential to the existence of an object. These tusks, though situated in a manner opposite to that of other teeth, are still teeth; the singularity of their direction cannot alter their nature, or convert a true canine tooth into an ivory horn.

These enormous quadruple tusks give this animal a formidable appearance; yet he is less dangerous perhaps than our wild boar. They go in herds, and have a strong odour, which betrays them to the dogs, who often hunt them with success. They growl in a frightful manner, and fight and defend themselves with their under tusks, the upper ones being rather incommodious than serviceable to them. Though brutal and ferocious they are easily tamed; and their flesh, which is very good, corrupts in a short time. As their hair is fine, and their skin thin, they make little resistance to the teeth of the dogs, who hunt them in preference to the boar, and accomplish their purpose with ease. In order to rest their head, or to sleep in a standing posture, they hook their upper tusks to the branches of trees. This practice is common to them and the elephant, which, to repose without lying down, supports its head by putting the ends of its tusks into holes that it digs for this purpose in the wall of its apartment.

The babiroussa differs likewise from the wild boar in natural appetites. He feeds upon herbs and the leaves of trees, and never enters the gardens to devour pot-herbs: but the boar, even in the same country, lives upon wild fruits and roots, and often lays waste the gardens. Besides, these animals, which go equally in herds, never intermix; the wild boars keep to one side, and the babiroussas to the other. The latter walk lightly, have a very fine scent, and often rise erect against the trees, in order to smell at a distance the approach of dogs or hunters. When hard pursued they run into the sea, where by swimming with as much facility as ducks, and even diving, they often escape the hunters; for they swim a long time, and sometimes to great distances from one island to another.

The babiroussa is found not only in the island of Bouro or Boero, near Amboina, but in several other parts of the south of Asia and Africa, as in Celebes, Estrila, Senegal, and Madagascar; for it appears that the wild boars of this island mentioned by Flacourt, *the males of which*, he remarks, *have chiefly two horns on the side of the nose*, are babiroussas. We have not been able to determine whether the females also be deprived of these two tusks, which are so remarkable in the male,

THE CABIAI, OR THICK-NOSED TAPIR.

THE thick-nosed tapir has the fore hoofs divided into four, and the hind hoofs into three, a very large and thick head and nose, small rounded ears, and large black eyes. The upper jaw is longer than the lower. There are two strong and great cutting teeth in each jaw; eight grinders in each jaw, and each of these grinders form on their surface seemingly three teeth, each flat at their ends. The legs are short, and the toes long, connected near their bottoms by a small web; their ends are guarded by a small hoof. It has no tail. The hair on the body is short, rough, and brown. On the nose there are long and hard whiskers. It grows to the size of a hog of two years old.

This animal was never seen in Europe, till the Duke de Bouillon had a young one transmitted to him from America. As this prince is exceedingly curious with regard to foreign animals, he has sometimes done me the honour of inviting me to examine them, and has even been kind enough to present me with several species. The animal under consideration was killed by the coldness of the climate before it had acquired its full growth. It is not a hog, as has been alledged by naturalists and

travellers; for it has only some slight relations to the hog, and differs from him in some remarkable characters. The cabiai never exceeds the size of a hog of eighteen months old. Its head is shorter, and its mouth less. Its feet are also very different from those of the hog; for its toes are connected by membranes. It has larger eyes and shorter ears. In dispositions and manners, it differs not less from the hog, than in the structure of its parts. It lives much in the water, where it swims like an otter, catches fishes with its mouth and feet, and eats them on the banks. It likewise eats grain, fruits, and sugar canes. As its feet are long and broad, it often sits on the hind ones. Instead of the grunting of a hog, its cry rather resembles the braying of an ass. It seldom walks but in the night, and then generally in company, without removing far from the margin of the water. As it runs badly, on account of the length of its feet, and the shortness of its legs, its safety consists not in flight. To escape the hunters, it plunges into the water, swims to a great distance, and remains so long concealed that they lose all hopes of getting another view of it. The flesh of it is fat and tender; but, like that of the otter, it has rather the taste of bad fish than of good flesh. It has been remarked, however, that its head is pretty good which corresponds with what is said of the beaver, that the flesh of its anterior parts is well tasted, while that of the posterior parts has the taste of fish. The cabiai is of a gentle and peaceable disposition; it neither quarrels, nor does mischief to other animals. It is easily tamed, obeys the voice, and follows spontaneously those with whom it is acquainted, and who treat it kindly. At Paris, it was fed with barley, salads, and fruits, and continued in good condition during the warm season. From the great number of paps, it appears, that the female is very prolific. We are ignorant of the times of gestation and growth, and consequently of the duration of its life. Our colonists at Cayenne might inform us with regard to these articles; for this animal is pretty common in Guiana, as well as in Brasil, the country of the Amazons, and other low lands of South America.

SUPPLEMENT.

We have little to add to the history and description of this American animal. M. de la Borde writes us, that it is very common in Guiana, and still more so in the neighbourhood of the Amazon river, where the fishes are very numerous. He remarks, that these animals go always in pairs, a male and a female; and that the largest of them weigh about a hundred pounds. They fly from the abodes of men, never leave the banks of rivers, and, when they perceive any person, they take to the water, without diving like the otters, but swimming like the hogs. Sometimes, however, they go to the bottom, and continue there a considerable time. They are often taken when young, and brought up in the houses, where they easily accustom themselves to eat bread, millet, and pot-herbs, though in a state of nature, they live chiefly on fishes. The females bring forth only one young at a time. They are by no means dangerous; for they never attack either men or dogs. Their flesh is white, tender, and well tasted. This last fact seems to contradict what is said by other travellers, that the flesh of the cabiai, has rather the taste of bad fish than of good meat. However, the flesh of the cabiai, when it lives on fish, may have this bad taste, and, when fed with bread or grain, it may be very good.

As we had this animal alive in Paris, and kept it a long time, I am persuaded that it might be propagated in our climate. I mentioned that it was killed by the cold. But I have since been informed, that it endured the winter's cold very well; but, as it was shut up in a garret, it threw itself down from the window, and fell into a vessel full of water, where it was drowned; which would not have happened, if it had not been hurt in the fall upon the edge of the vessel.

THE PORCUPINE.

THE porcupine has two cutting teeth in each jaw; the body is covered with long, hard, and sharp quills, and the upper lip is divided. The crested porcupine has a long crest on the top of the head, reclining backward, and formed of stiff bristles. The body is covered with long quills; those on the hind part of the body being nine inches in length, very sharp at the ends, and varied with black and white. Between the quills are a few hairs. The head, belly, and legs are covered with strong bristles, terminated with soft hair of a dusky colour. The whiskers are long, and the ears are like the human. It has four toes before, and five behind. The tail is short, and covered with quills. The length, from nose to tail, is two feet, and that of the tail four inches.

The name given to this animal in most European languages leads to the notion that it is a hog covered with bristles, though it has no resemblance to the hog but in the grunting noise it makes. It differs from the hog as much as any other quadruped, both in figure and internal structure. Instead of a long head, furnished with

long ears, armed with tusks, and terminated by a snout; instead of cloven feet, covered with hoofs, like the hog; the porcupine has a short head, like the beaver, two large cutting teeth in each jaw, no tusks or canine teeth, the upper lip divided like that of the hare, round flat ears, and feet armed with claws. Instead of a large stomach with an appendix shaped like a cowl, which, in the hog, seems to form the shade between the ruminating and other quadrupeds, the porcupine has only a simple stomach and a large cæcum. The parts of generation are not apparent, as in the boar; and the testicles are hid in the groins. From these characters, joined to the short tail, the long whiskers, and the divided lip, we may conclude that the porcupine makes a nearer approach to the hare or the beaver than to the hog. The hedge-hog, which, like the porcupine, is armed with prickles, has a greater resemblance to the hog; for its muzzle is long, and terminates in a kind of snout. But, all these resemblances being slight, and the differences conspicuous, the porcupine unquestionably constitutes a particular species, totally distinct from that of the hedge-hog, the beaver, the hare, or any other animal to which fancy may compare it.

Travellers and naturalists have attributed to the porcupine the faculty of darting its quills to a distance, and with such force as to inflict deep wounds: they have likewise said, that the quills, when separated from the body of the animal, possess the extraordinary power of penetrating, by their own proper exertion, deeper into the flesh, as soon as their points have entered. This last fact is purely imaginary, and the first is equally false as the second. The error seems to have originated from this circumstance, that the porcupine, when irritated, erects and moves his quills; and, as some of them are attached to the skin by a delicate pedicle only, they easily fall off. We have examined living porcupines, and, though violently agitated, we never saw them discharge their quills like darts. It is not a little surprising, therefore, that the gravest authors, both ancient and modern, as well as the most sensible travellers, should join in giving their suffrages to a falsehood. Some of them tell us that they themselves have been wounded by these darts: others affirm, that the quills are discharged with such violence as to pierce a plank at the distance of several paces.

[From this group of credulous travellers, we must except Dr. Shaw. 'Of the many porcupines which I have seen in Africa, I never knew any of them, though very much provoked, that could dart their quills. Their usual method of defence is, to recline themselves on one side, and, upon the enemy's near approach, to rise up quickly, and gore him with the erected prickles upon the other.'—*Shaw.* P. Vincent-Marie by no means asserts that the porcupine darts his quills: he only says, that this animal, when he meets with serpents, against whom he carries on a perpetual war, rolls himself up like a ball, concealing his head and feet, and then rolls upon, and kills them with his bristles, without running any risk of being wounded. He adds, what we believe to be true, that, in the stomach of the porcupine, different kinds of bezoar are formed. Some of these are only a mass of roots enveloped with a crust; others, which are smaller, seem to be composed of pieces of straw and sand; and the smallest kind, which exceed not the size of a nut, appear to be real petrifactions. We have no doubt as to the truth of these facts; for we found a bezoar of the first kind, or an ægagropilus, in the stomach of a porcupine which was sent to us from Italy.]

The marvellous always augments and gathers force in proportion to the number of heads through which it passes. Truth, on the contrary, loses in performing the same route. Notwithstanding the absolute negative I have stamped on these two fictions, I am persuaded that it will still be repeated by a thousand future writers, that the porcupine darts his quills, and that these quills, when separated from the animal, penetrate deeper, by their own proper exertion, into the bodies which they have once entered.

The porcupine, though originally a native of the warmest climates of Africa and India, can exist and multiply in colder countries, such as Persia, Spain, and Italy. Agricola remarks, that the porcupine was not transported into Europe long before his time. It is found in Spain, and more commonly in Italy, particularly in the Apennine mountains in the environs of Rome. It was from this last place that M. Mauduit, who, stimulated by his love of natural history, sent us the porcupine which M. Daubenton has described.

Aristotle, Pliny, and all the naturalists, tell us, that the porcupine, like the bear, conceals itself during the winter, and brings forth in thirty days. These facts we have not been able to ascertain; and it is singular that, in Italy, where the animal is common, and where, at all periods, there have been learned philosophers and acute observers, no man has ever written its history. On this subject, as well as on many others. Aldrovandus has only copied Gessner; and the gentlemen of the Academy, who have described and dissected eight porcupines, say little or nothing concerning their œconomy and manners. We only learn from the testimony of travellers, and of those who keep the porcupine in menageries, that, in a domestic state, it is neither wild nor ferocious, but only anxious for liberty; and that, by the assistance of its fore teeth, which are strong and sharp, like those of the beaver, it cuts wood, and pierces the door of its cage. We likewise know, that it is easily fed upon crumbs of bread, cheese, and fruits; that in a state of liberty it lives upon roots and wild seeds; that when it gets admission to a garden it makes great havock, and devours

all kinds of pot-herbs with avidity; that, like most other animals, it becomes fat about the end of summer; and that its flesh, though somewhat insipid, is not bad to eat.

[There are porcupines in Guinea. They grow to the height of two or two and a half feet, and their teeth are so sharp and strong that no wood can resist them. I put one into a barrel, imagining that it was sufficiently secured: but in one night it gnawed through the wood, and made its escape.—*Bosman.*]

By examining the form, substance, and organizaton of the quills, we easily perceive that they are tubes, and only want vanes to be real feathers. From this circumstance the porcupine constitutes the shade between quadrupeds and birds. The quills, particularly those near the tail, make a noise by striking each other when the animal walks. He can elevate or depress his quills as the peacock raises or lowers the feathers of his tail. Hence the muscular part of the skin is capable of acting with force, and its structure is nearly the same with that of some birds. We have marked these relations, though not very apparent. It is always fixing one point in nature, who often escapes our researches, and seems in her productions to sport with those who wish to cultivate her acquaintance.

THE COENDOU, OR BRASILIAN PORCUPINE.

THE Brasilian porcupine has a short blunt nose, and long white whiskers. Beneath the nose is a bed of small spines. The top of the head, back, sides, and base of the tail, are covered with spines. The longest on the lower part of the back and tail are three inches in length, very sharp, white, and barred near their points with black. They adhere closely to the skin, which is quite naked between them. They are shorter and weaker as they approach the belly; and on the breast, belly, and lower part of the legs, they are converted into dark brown bristles. The feet are divided into four toes, and the claws are very long. On the place of the thumb there is a great protuberance. The tail is eighteen inches long, slender, and taper towards the end; the last ten inches of it is almost naked, having only a few hairs on it, and has for that length a strong prehensile quality.

In every article we have treated of there are more errors to detect than truths to relate. The source of these errors is to be derived from this circumstance, that of late the history of animals has been solely composed by men who are prejudiced with methodical arrangements, and who mistake their trifling systems for the genuine registers of nature. No animals belonging to the warm climates of the Old Continent exist in America; neither are any of the South American animals to be found under the Torrid Zone of Africa and Asia. The porcupine, as formerly remarked, is an original inhabitant of the warm countries of the Old World; and having never been found in the New, his name has been transferred to such animals as resembled him, and particularly that now under consideration. On the other hand the coendu of America has been transported to the East Indies; and Piso, who probably knew not the porcupine, made Bontius, who treats only of animals belonging to the south of Asia, engrave the American coendou under the name of the true porcupine; so that at first sight we would be tempted to think that this animal existed equally in America and in Asia. With a little attention, however, it is easy to perceive that Piso, who in this article, as well as in most parts of his work, is but the plagiary of Marcgrave, has not only copied Marcgrave's figure of the coendou into his history of Brasil, but likewise engraved it again for Bontius's work, which he digested and published. Hence, though we have the figure of the coendou in Bontius, we must not conclude that it exists in Java, or in any other part of the East Indies, nor take this figure for that of the porcupine, between which and the coendou there is no similarity, except that both have quills or spines.

It is to Ximenes, and afterwards to Hernandez, that we owe our first knowledge of this animal, which they have pointed out under the Mexican name of *hoitzlacuatzin:* the *tlacuatzin* is the opossum; and *hoitzlacuatzin* should be translated the *bristly* or *spinous opossum.* This denomination has been ill applied; for these animals have very little resemblance. Marcgrave has not adopted this Mexican name, but calls the animal by its Brasilian name *cuandu.* Marcgrave, however, ought to have perceived, that his Brasilian cuandu was the same animal with the hoitzlacuatzin of Mexico, especially as his figure and description correspond very well with those of Hernandez; and as Laet, the editor and commentator of Marcgrave, says in express terms, that the spinous tlacuatzin of Ximenes and the cuandu are probably the same animal. From the few notices to be collected from travellers, it appears that there are two varieties of these animals, which the naturalists have copied from Piso into their catalogues as two distinct species, namely, the great and the small cuandu. But the error or the negligence of Piso is apparent; for though he gives

these coendous in two separate articles, and seems to regard them as distinct species, he represents both by the same figure: hence we are entitled to pronounce them to be the same animal. There are also some naturalists who not only make two species of the great and small coendou, but have separated them from the hoitzlacuatzin, and given the whole three as different animals: I acknowledge, indeed, that though the coendou and hoitzlacuatzin are probably the same animal, their identity is not so certain as that of the great and small coendou.

However this matter stands, the coendou is not the porcupine. The former is much smaller. His head and muzzle are proportionally shorter. He has no plume or crest on his head, and his upper lip is not devided. He has a long tail; but that of the porcupine is very short. He is rather a carnivorous than a frugivorous animal; for he endeavours to surprise birds, small quadrupeds and poultry, while the porcupine lives upon pot-herbs, roots, and fruit. Like the hedgehog, he sleeps during the day, and moves about in the night. He climbs trees, and suspends himself by the tail upon the branches. He may be tamed. He commonly lives in elevated places; and he is found through the whole continent of America, from Brasil and Guiana as far as Louisiana and the southern parts of Canada. But the porcupine is confined to the warm regions of the Old Continent.

By conferring the name of porcupine upon the coendou, the same powers have also been ascribed to him, particularly that of shooting his quills. It is astonishing that naturalists and voyagers should agree in this fact, and that Piso, who ought to have been less superstitious, because he was a physician, should gravely tell us, that the quills of the coendou pierce the flesh by their own proper force, and penetrate into the bowels of an animal. Though these facts be evidently absurd, Ray is the first author who denied them. But how many absurdities have been exposed by men of sense, which are still daily affirmed by other men who believe they possess greater portion of understanding?

SUPPLEMENT.

In Guiana there are two species of coendoes. The largest weighs from twelve to fifteen pounds. They keep always on the highest trees. They eat none during the day. Their odour is very strong, and felt at a great distance. The females bring forth their young, to the number of two, in the holes of trees. They feed on the leaves of these trees, and are not very common. Their flesh is extremely good; and the negroes prefer it to that of the paca. According to M. de la Borde the two species never mix. They are never found in pairs except in the season of love. At other times they are solitary; and the females never quit the tree in which they are brought forth. These animals are apt to bite; but their bite is neither strong nor dangerous.

The individuals of the small species weigh about six pounds. They are not more numerous than the others. The tigers are deadly foes to the coendous; and they never appear on the ground during the day.

THE CANADA PORCUPINE.

THE Canada porcupine has short ears, hid in the fur. The head, body, legs, and upper part of the tail, are covered with soft, long, dark brown hair. On the upper part of the head, back, body, and tail, there are numbers of sharp strong quills: the longest are on the back, the least towards the head and sides. The longest are three inches; but all are hid in the hair. Intermixed are some stiff straggling hairs three inches longer than the rest, and tipt with dirty white. The under side of the tail is white. There are four toes on the fore feet, five behind, each armed with long claws, hollowed on their under side. The form of the body is exactly that of the beaver, but is not half the size. One which Mr. Banks brought from Newfoundland was about the size of a hare, but more compactly made. The tail was about six inches long.

This animal has never received a proper name. Placed by nature in the desert regions of North America, it enjoys an independent existence, remote from man, from whom it has obtained no denomination, which is the first badge of his empire. Hudson having discovered the land which it inhabits, we shall give it a name which recalls that of its first master, and indicates at the same time its poignant and bristly nature. Besides, it was necessary to bestow a name upon it, to prevent its being confounded with the porcupine, or the coendou, which it resembles in some characters, but differs so widely from them in all others that it ought to be regarded as a particular species. It likewise belongs to a northern climate, while the other two are natives of the south.

Edwards, Ellis, and Catesby, have all mentioned this animal. The figures given by the two first authors correspond with ours; and we doubt not but they are the same species. We are even tempted to believe that

the animal described and engraved by Seba, under the name of *a singular East India porcupine*, and which was afterwards pointed out by Klein, Brisson, and Linnæus, in their methodical catalogues, by the characters given by Seba, might be the same with the animal under question. This would not, as formerly remarked, be the only time that Seba has exhibited American animals as belonging to the East Indies. We cannot, however, be so certain with regard to this animal as we have been with several others. We shall only say, that the resemblances appear to be very great, and the differences but slight; and that, as these animals are little known, the differences may be only individual varieties, or those which distinguish males and females.

The Canada porcupine might be called the *bristly beaver*. It is a native of the same country, is of the same size, and has nearly the same figure. Like the beaver, it has two long, sharp, and strong cutting teeth in each jaw. Independent of its quills, which are short, and almost concealed among the hair, it has, like the beaver, a double fur, the first consisting of long soft hairs, and the second of a down still more soft. When the animal is young, the quills are proportionally larger, and more apparent, and the hairs are shorter and thinner than in the adults.

This animal avoids all kind of moisture. He retires and deposits his excrements under the roots of hollow trees. He sleeps much, and feeds chiefly on the bark of the juniper bushes. In winter, the snow serves him for drink; and, in summer, he drinks water, which he laps like a dog. The savages eat his flesh, and clothe themselves with his fur, after depriving it of the quills and bristles.

THE TANREC AND THE TENDRAC, OR ASIATIC HEDGEHOG.

THE *tendrac*, or Asiatic hedgehog, with a long slender nose, short rounded ears, and short legs. The upper part of the body is covered with short spines, white, and marked across the middle with rust colour. The face, throat, belly, buttocks, and legs are thinly covered with whitish, fine, but hard hair. The tail is very short, and covered with spines. About the nose there are some hairs above two inches long. It is of the size of a mole.

The other, or the *Tanrec*, is rather larger. It is covered with spines only on the top and hind part of the head, the top and sides of the neck, and the shoulders; the longest were on the upper part of the neck, and stood erect. The rest of the body was covered with yellowish bristles, among which were intermixed some that were black, and much longer than the others. Each of these animals, which are varieties of the same species, had five toes on each foot.

The *tanrecs* or *tendracs* are small East Indian animals which have some resemblance to our hedgehog, but differ so much from it as to constitute a distinct species. This is apparent, independent of inspection or comparison; for they never roll themselves up into a ball, like the hedgehog; and besides, the tanrecs are found in Madagascar, where there are also hedgehogs of the same kind with ours, which bear not the name of *tanrec*, but are called *sora*.

There seems to be two species, or perhaps two races of tanrecs: the first, which is nearly as large as our hedgehog, has a muzzle proportionally longer than the second; its ears are also more apparent, and it has fewer bristles than the other, to which we have given the name of *tendrac*, to distinguish it from the first. This tendrac is not larger than a large rat. Its muzzle and ears are shorter than those of the tanrec, which last is covered with smaller bristles, but equally numerous with those of the hedgehog. The tendrac, on the contrary, has no spines but on the head, the neck, and the withers, the rest of the body being covered with coarse hair, like hogs bristles.

These small animals, which have short legs, move very slowly. They grunt and wallow in the mire like hogs. They are fond of water, in which they dwell longer than upon land. They are caught in salt water, in canals, and in small gulfs of the sea. They are very ardent in their amours, and multiply greatly. They dig holes in the ground, into which they retire, and lie in a torpid state during several months. In this state, their hair falls off, which grows again after they awake. They are generally very fat; and, though their flesh be insipid and reedy, the Indians eat it with pleasure.

THE GIRAFFE, OR CAMELOPARD.

THE camelopard has short strait horns, covered with hair, truncated at the end, and tufted with hair. In the forehead, there is a tubercle about two inches high, resembling a third horn. The height, from the crown of the head to the soles of the fore feet, is seventeen feet, and that from the top of the rump to the bottom of the hind feet, only nine: the length of the body is seven, and from the withers to the loins, only six feet. The fore legs are not longer than the hind legs; but the shoulders are of a vast length, which give the disproportionate height between the fore and hind parts. The horns are six inches long. The head is like that of a stag. The neck is slender and elegant, and on the upper side there is a short mane. The ears are large, and the tail long, with strong hairs at the end. The colour of the whole animal is a dirty white, marked with large, broad, rusty spots.

The camelopard is one of the most beautiful and largest quadrupeds: without being noxious, he is at the same time extremely useless. The enormous disproportion of his legs, of which those before are double the length of those behind, prevents him from exercising his powers. His body has no stability; he has a staggering gait; and his movements are slow and constrained. When at liberty, he cannot escape from his enemies, nor can he serve man in a domestic state. The species is not numerous, and has always been confined to the deserts of Æthiopia, and to some provinces in the south of Africa and India. As these countries were unknown to the Greeks, Aristotle has made no mention of this animal. Pliny speaks of it, and Oppian describes it in a manner which is by no means ambiguous. The camelopardalis, this last author remarks, has some resemblance to the camel. Its skin is spotted like that of the panther, and its neck is as long as that of the camel. Its head and ears are small, its feet large, and its legs long, but unequal, those before being much taller than those behind, which are very short, and seem to bring the rump of the animal down to the ground. Upon the head, near the ears, there are two eminences like two small straight horns. Its mouth resembles that of the stag; the teeth are small and white, the eyes brilliant. the tail short, and garnished with black hairs at the point. By adding to this description of Oppian those of Heliodorus and Strabo, we shall have a pretty just idea of the camelopard. The Ethiopian ambassadors, says Heliodorus, brought an animal of the size of a camel, whose skin was marked with lively spots and brilliant colours, and whose posterior parts were much lower than the anterior. The neck, though attached to a pretty large body, was thin, the head, in figure, resembled that of the camel, and, in size, it was not twice as large as that of the ostrich. The eyes appear to be tinged with different colours. The gait of this animal was different from that of all other quadrupeds, which in walking lift their feet diagonally, that is, the right fore foot with the left hind foot. But the comelopard ambles naturally, lifting the two right or the two left feet together, It is a gentle creature, and may be conducted at pleasure by a small cord put round its head. There is, says Strabo, a large animal in Ethiopia, called *camelopardalis*, though it has no resemblance to the panther; for its skin is not spotted in the same manner. The spots of the panther are circular, and those of the camelopard resemble the spots of the fawn or young stag. The posterior parts of its body are much lower than the anterior; so that at the rump it is not higher than an ox, and at the shoulders it is higher than a camel. From this disproportion of parts, its motions should not be quick. It is a mild animal, does no mischief, and feeds upon herbs and leaves.

Belon is the first author who has given a good description of the camelopard. 'I saw,' says he, 'at the 'castle of Cairo, an animal commonly called *zurnapa*. It 'was formerly denominated *camelopardalis*, a name com-'pounded of *leopard* and *camel*; for it is variegated with 'the spots of a leopard, and has a long neck, like the 'camel. It is a most beautiful creature, as gentle in its 'dispositions as a sheep, and more amiable than any 'other wild beast. Its head is nearly similar to that of 'the stag, except in size. Its horns are blunt, six 'inches long, and covered with hair; those of the male 'are longer than those of the female. Both male and 'female have large ears, like those of a cow, and a black 'tongue resembling that of an ox. It has no teeth in 'the upper jaw. The neck is long, straight and slender. 'The horns are round and delicate, the legs long and 'slender, and those behind are so low, that the animal 'seems to stand on end. Its feet resemble those of an 'ox. Its tail, which hangs as low as the hock, is round, 'having hairs three times as gross as those of a horse. 'The hair on the body is white and red. Its manner of 'running is similar to that of the camel. When it runs, 'the two fore feet move together. It lies on its belly, 'and has hard protuberances on its breast and thighs. like 'the camel. When standing, it cannot browse the grass,

'without spreading its fore feet very wide, and even 'then the operation is performed with great difficulty; 'for which reason it could not live in the fields, if it 'were not supplied with the leaves and sprigs of trees.'

The description of Gillius is still better than that of Belon. 'I saw, (says Gillius,) three giraffes at Cairo. 'They had two horns of six inches in length, and, on 'the middle of the front, a protuberance about two 'inches high, which resembled a third horn. This 'animal, when he raises his head, is sixteen feet high; 'the neck alone is seven feet; and the length, from the 'extremity of the tail to the end of the nose, is twenty-'two feet. The fore and hind legs are nearly of an 'equal height. But the fore thighs are so dispropor-'tionally long, that the back of the animal inclines like 'the roof of a house. The whole body is marked with 'large yellow spots, nearly of a square figure. It has 'cloven feet like the ox. The upper lip protrudes be-'yond the under. The tail is slender with hairs at the 'point. It ruminates and eats herbage, like the ox. Its 'mane extends from the top of the head along the back. 'When it walks, its legs and flanks on both sides seem 'to be alternately lame; and, when it browses herbage 'or drinks, it is obliged to spread its fore legs prodi-'giously wide.'

Gessner quotes Belon for affirming that the horns of the giraffe fall off like those of the fallow deer. I could never discover this fact in Belon. He only says, in the above passage, that the horns of the giraffe are covered with hair. He makes no other mention of this animal, except when treating of the axis, where he remarks, 'that the ground colour of the giraffe is white, and that 'the large spots scattered over the body are reddish, but 'not so red as those of the axis.' This fact, however, which I can no where discover, would be of great importance in determining the nature of the giraffe; for, if its horns shed annually, it belongs to the deer kind; and, on the other hand, if its horns are permanent, it must be referred to the ox or goat kind. Until we obtain a distinct knowledge of this fact, we cannot affirm, as our nomenclators have done, that the giraffe belongs to the genus of stags; and it is astonishing that Hasselquist, who has lately given a very long, and very inanimated description of this animal, has said nothing concerning its nature.

In the year 1764 a drawing of the giraffe, accompanied with some remarks, was sent to the academy of sciences, from which we learn, that this animal, which was thought peculiar to Ethiopia, is likewise found in the neighbourhood of the Cape of Good Hope. [The giraffe is no where to be found but in Ethiopia. I saw two tame ones in the royal palace. I remarked, that when they wanted to drink they were obliged to spread the fore legs very wide, otherwise, though their necks were long, they could not reach the water. What I relate I saw with my eyes.—*Thevenot.*] The figure is so incorrect that no use can be made of it; but as the remarks contain a kind of description they merit insertion: 'In an expedition made in the year 1702, two 'hundred leagues to the north of the Cape of Good 'Hope, we found the camelopardalis, whose figure we 'have subjoined. The body resembles that of an ox, 'and the head and neck those of a horse. All those we 'met with were white with brown spots. It has two 'horns, and cloven feet. The two we killed, and whose 'skins have been transmitted to Europe, were of the 'following dimensions: the length of the head one foot 'eight inches; the height, from the extremity of the 'fore foot to the withers, ten feet; and from the withers 'to the top of the head seven feet; in all seventeen feet 'high. The length, from the withers to the reins, is five 'feet six inches, and from the reins to the tail one foot 'six inches: thus the whole length of the body is seven 'feet. The height, from the hind feet to the reins, is 'eight feet six inches. From the disproportion in the 'height and length, it appears that this animal can be 'of little use. He feeds upon the leaves of trees; and 'when he wants to drink, or to take any thing from the 'surface of the earth, he is obliged to bend down on 'his knees.'

In examining what travellers have said concerning the giraffe, I find they all agree, that this animal when in its natural situation can reach with its head from sixteen to seventeen feet high; and that its fore legs are twice as long as the hind legs; so that when it sits on its crupper it seems to be entirely on end. They likewise agree, that on account of this disproportion it cannot run quickly; that its dispositions are extremely mild; that by this quality, as well as by other physical habits, and even by the form of the body, it approaches nearer to the nature of the camel than any other animal; and that it is one of the ruminating animals, and like them wants the cutting teeth in the upper jaw. We likewise learn, from the testimony of some voyagers, that this animal is found in the southern parts of Africa as well as in those of Asia.

[In the island of Zanzibar, in the neighbourhood of Madagascar, there is a certain quadruped called *graffe* or *giraffe*, which has a neck about a fathom and a half in length, and its fore legs are much longer than those behind. Its head is small, and of different colours, as well as the body. This animal is very mild and tame, and never injures any person.—*Marc Paul.*]

From what we have related, it is evident, that the giraffe is a peculiar species, and very different from all others. He seems, however, to make a nearer approach to the camel than to the stag or the ox. It is true the giraffe has two horns, and the camel has none: but the other resemblances are so numerous, that I am not surprised to see the appellation of *Indian camel* bestowed

on him by some travellers. Besides, we know not the substance of which the horns of the giraffe are composed; and, consequently, we know not whether by this part he approaches nearer to the stag or to the ox: they may perhaps be a substance very different from either. They may be composed of a congeries of hairs, like the horns of the rhinoceros; or they may be a substance of a peculiar texture. Nomenclators seem to have been first led into the blunder of ranking the giraffe with the stags by the pretended passage of Belon, quoted by Gessner, which if real would be decisive of the point: they appear likewise to have misunderstood what has been mentioned by authors concerning the hair of these horns. They imagined that these writers had said, that the horns of the giraffe were clothed with hair, like the new sprung horns of the stag; and hence concluded that they were of the same nature. We see, on the contrary, from the notes above quoted, that the horns of the giraffe are only surrounded with hair, and have a tuft of large coarse hairs at the point, and not clothed with a down or velvet, like those of the stag. From this circumstance it is not improbable, that the horns of the giraffe are composed of a congeries of hairs nearly in the same manner as those of the rhinoceros: their blunt or truncated points seem to favour this idea. Besides, if we consider that in all animals which carry *wood* instead of horns, as the elk, the rain-deer, the stag, the roe-buck, &c. this *wood* is always divided into branches or antlers, and that on the contrary the horns of the giraffe are simple, and consist but of one stem, we will be convinced that they are not of the same nature, unless analogy in this instance be entirely violated. The tubercle on the front, which appears to be a third horn, strengthens this opinion. The two horns, which are not pointed, but blunt at the extremities, are perhaps only tubercles of a greater length than the former. The females, according to the testimony of all travellers, have horns as well as the males, only they are somewhat smaller. If the giraffe really belonged to the deer kind, analogy would again suffer violation; for among all the animals of this kind, none of the females, except the female rain deer, have horns, and we have given the reason of this phænomenon. On the other hand, as the giraffe, on account of the excessive height of its limbs, cannot feed upon herbage but with great difficulty; as its chief and almost only food consists of the leaves and buds of trees, it may be presumed, that the substance of the horns, which are the most conspicuous residue of the organic particles derived from the food, is analogous to wood, like that of the stag. Time will confirm one or other of these conjectures.

SUPPLEMENT.

We here give the figure of the giraffe from a drawing transmitted to us from the Cape of Good Hope, which we have rectified in some points from the information of Mr. Bruce. With regard to the horns of this animal, we are still uncertain whether they are permanent, like those of the ox, antilope, goat, rhinoceros, &c. or whether they are annually renewed like those of the deer kind. They seem to grow during the first years of the animal's life; but they never rise to a great height; for the longest which have been seen exceeded not twelve or thirteen inches; and they are generally not above six or eight inches. We are indebted to M. Allamand, a celebrated professor at Leyden, for the exact knowledge we have obtained concerning these horns. The following is an extract of a letter he wrote on this subject to M. Daubenton, dated October 31, 1766.

'I have the honour to inform you, that I am in possession of a stuffed giraffe. Both you and M. de Buffon have expressed a desire to know the nature of its horns. I have cut off one of them, which I send you, that you may have a more exact idea of it. You will remark, that this giraffe was very young. The governor of the Cape, from whom I received it, writes me, that it was killed when lying near its mother. Its height is about six feet, and its horns of course are short, not exceeding two inches and a half. They are every where covered with skin and hairs; and those at the point are much longer than the others, and form a pencil, the height of which exceeds that of the horn. The base of the horn is more than an inch broad, and consequently forms an obtuse cone. To discover whether it was hollow or solid, I sawed it through longitudinally, along with a portion of the skull to which it adhered. I found it to be solid, and a little spongy, because it had not yet acquired all its consistence. Such is its texture, that it appears not to be composed, like that of the rhinoceros, of hairs united together; and it resembles the horns of the stag more than those of any other animal. I would even say, that there is no difference between these two substances, if I were certain that a horn lately sent to me under that name was really the horn of a giraffe. It is straight, half a foot long, and pretty much pointed. There still remain some vestiges of the skin with which it had been covered; and it differs from a stag's horn only in figure. If these observations are not sufficient, I shall with pleasure send you the two horns, that you may examine them along with M. de Buffon. With regard to this animal I should farther remark, that the alledged difference between its fore and hind legs seems to be greatly exaggerated; for it is hardly perceptible in my young giraffe.'

Beside these horns, which are found on the head of the female giraffe, as well as on that of the male, there is, at almost an equal distance between the nostrils and eyes, a remarkable excrescence, which seems to be a bone covered with a soft skin, and garnished with smooth

hair. This osseous excrescence is more than three inches long, and is much inclined towards the front, or makes a very acute angle with the bone of the nose. The colour of this animal's robe is a bright shining yellow, and the spots are in general rhomboidal.

It is extremely probable, from the inspection of these horns, which are solid, and resemble in substance the horns of the stag, that the giraffe may be ranked in the same genus: of this there could not remain a doubt if we were certain that he shed his horns annually. But it is now unquestionable that he ought to be separated from the ox kind, and other animals whose horns are hollow. Meanwhile, we shall consider this large and beautiful animal as constituting a particular and solitary genus, which corresponds very well with the other facts in nature, who in voluminous species never doubles her productions. The elephant, the rhinoceros, the hippopotamus, and perhaps the giraffe, are animals forming particular genera, or solitary species, who have no collaterals. This is a privilege which seems to be conferred solely on animals which greatly surpass all others in magnitude.

In a letter I received from Holland, the subscription of which was illegible, I had the following description of a giraffe:

'Africa produces no animal more beautiful or more 'curious than the giraffe. From the point of the nose 'to the tail he is twenty-five feet long. He has received 'the name of *camelopard* because he somewhat resembles 'the camel in the figure of his head, the length of his 'neck, &c. and because his robe is variegated with irregular spots, like that of the leopard. He is found at 'twenty-four leagues from the Cape of Good Hope, and 'is still more frequent at greater distances. The teeth 'of this animal are similar to those of the stag. His 'horns are a foot long: they are straight as a man's 'arm, garnished with hair, and seem to be truncated at 'their extremities. The neck constitutes at least one 'half of the length of the animal, which in figure pretty 'much resembles that of a horse. The tail would also 'be pretty similar if it were equally furnished with hair 'as that of the horse. The legs are like those of the stag; 'the feet are garnished with very black, obtuse, and 'widely separated hoofs. When the animal leaps he 'first raises the two fore feet, and then those behind, as 'a horse would do who had his two fore feet tied together. 'He runs slowly, and with a bad grace: he may be easily 'overtaken in the chase. He carries his head always 'high, and feeds on the leaves of trees only, being unable 'to pasture on the ground on account of his great 'height. When he drinks he is obliged to rest on 'his knees. The females are generally of a bright 'yellow colour, and the males of a brownish yellow. 'Some of them are nearly white, with brown or black 'spots.

Supplement from Schneider's edition.

'M. de Buffon, with much propriety, blames our 'modern nomenclators, because, when treating of the 'giraffe, they are silent with regard to the nature of his 'horns, which alone can form a criterion to ascertain 'the species to which he belongs; and because they 'give dry and minute descriptions, without adding a 'figure. We shall endeavour to supply both these 'defects.

'M. Allamand, professor of natural history in the 'university of Leyden, is in possession of the stuffed 'skin of a young giraffe. He obligingly communicated 'to us a drawing of it, which we caused to be engraved; 'and he added the following description.

'M. Tulbagh, governor of the Cape of Good Hope, 'who has enriched our academical cabinet with many 'rare productions of nature, writes me, that the young 'giraffe in our possession was killed by his hunters at a 'considerable distance from the Cape, when lying near 'its mother, whom it still sucked. Hence it appears, 'that the giraffe is not peculiar to Ethiopia, as Thevenot has alledged.

'As soon as I received it, I examined the horns, with 'a view to elucidate M. de Buffon's doubt with regard 'to their substance. They are not hollow like those of 'oxen and goats, but solid, and nearly of an uniform texture, like those of the stags, from which they differ only 'in being thinner, straighter, and not divided into branches 'or antlers. They are totally covered with the skin of 'the animal; and, for three-fourths of their length, this 'skin is furnished with short hair, similar to that which 'covers the body. Toward the points, the hair becomes 'longer, rises about three inches above the blunt end of 'the horns, and is of a black colour. Hence it is very 'different from the down on the young horns of the stag.

'These horns appear not to be composed of united 'hairs, like those of the rhinoceros. Their texture is 'likewise totally different. When sawn through, longitudinally, we perceive that they consist of a hard 'plate, which constitutes their external surface, and 'incloses a spongy substance. This, at least, is the case 'with the horns of my young giraffe. Perhaps the 'horns of adults are more solid. M. de Buffon is now 'in a condition to determine this point; for, along with 'the horns of my giraffe, I sent him another belonging 'to one more advanced in years, which a friend of mine 'received from the East Indies.

'Though these horns are solid, like those of the stag, 'I suspect that the animal does not shed them annually. 'They seem to be an excrescence of the frontal bone, 'like the bone which serves as a nucleus to the hollow 'horns of oxen and goats; and, consequently, it is impossible that they can fall off. If this conjecture be 'well founded, the giraffe constitutes a particular genus,

'perfectly distinct from the animals which shed their 'horns, and also from those which have hollow, but per- 'manent horns.

'In the middle of the front of adult giraffes, there is 'a protuberance which seems to be the rudiments of a 'third horn. No such protuberance appeared in our 'giraffe; probably because it was too young.

'All the authors, both ancient and modern, who de- 'scribe this animal, tell us, that the fore legs are twice 'as long as the hind ones. They could not possibly be 'deceived concerning a character so striking. But I 'can affirm, that in this article the giraffe must change 'greatly in growing; for, in our young one, the hind 'legs were equally long with those before. This circum- 'stance, however, prevents not the anterior part of the 'giraffe from being higher than the posterior, which is 'owing to the difference in the thickness of the body, 'as may be seen in the figure. But this difference is by 'no means so great as has been represented.

'The neck of the giraffe is the first thing which 'strikes a spectator. It is longer than that of any other 'quadruped, not excepting the camel, who, besides, folds 'his neck in different ways, which the giraffe seems to 'be incapable of performing.

'His colour is a dirty white, interspersed with yel- 'lowish spots, very near each other on the neck, more 'distant on the rest of the body, and of a figure which 'approaches to a parallelogram or rhomb.

'The tail is slender, in proportion to the length and 'stature of the animal. Its extremity is garnished with 'a tuft of black hairs, which are seven or eight inches 'long.

'The mane is composed of reddish hair, three inches 'long, and inclined toward the hind part of the body. 'It extends from the head along the neck, and down to 'the middle of the back, and, at the distance of some 'inches, it is again continued; but the hair inclines 'toward the head. It seems to recommence near the 'origin, and to extend to the extremity of the tail: but 'the hairs are short, and scarcely to be distinguished 'from those which cover the rest of the body.

'The eye-lids, both superior and inferior, are gar- 'nished with a range of very stiff hairs. There are 'similar hairs, but thinly scattered, round the mouth.

'The aspect of the giraffe indicates a mild and docile 'animal; and this is the character given of him by those 'who have seen him alive.

'This description of the giraffe, added to what M. de 'Buffon has collected from different authors, and ac- 'companied with the figure, is sufficient to give us 'more exact ideas concerning this animal than we had 'hitherto obtained.'

M. Alamand's great knowledge and accuracy, in every subject of which he treats, are apparent from the above description. I would have copied his engraving if his giraffe had not been too young. The figure I have given is that of an adult. I shall only remark, that I suspect the longest of the horns he was so obliging as to send me does not belong to a giraffe. The short ones are very thick, while it is very thin in proportion to their respective lengths. In the anonymous description above related, it is said, that the horns of the adult giraffes are *a foot in length, and as thick as a man's arm.* If the horn under consideration, which is half a foot long, really belonged to a giraffe, it ought to be double its present thickness. Besides, this pretended horn of a giraffe is so similar to the first horns of a young stag, that it may be regarded as belonging to the latter animal.

As to the nature of the giraffe's horns I am inclined to adopt M. Alamand's opinion. The protuberance on the front, which is unquestionably osseous, makes a kind of third horn. The horns adhered to the cranium, without the support of moulds; and, consequently, ought to be considered as osseous prolongations of the bones of the head. The hair which surrounds and over- tops them has no resemblance to that which covers the young shoots of the stag or fallow deer. This hair seems to be permanent, as well as the skin from which it issues. Hence the horn of the giraffe is a bone, and differs from that of the ox by its covering, the latter being surrounded with a horny substance, or hollow horn, and the former with hair and skin.

THE LAMA AND THE PACOS.

THE lama, or camel of Chili and Peru, has an almost even back, small head, fine black eyes, and very long neck, bending much, and very protuberant near the junction with the body. In a tame state it has smooth short hair; in a wild state long coarse hair, which is white, gray, and russet, disposed in spots. According to Hernandez it is yellowish, with a black line from the head along the top of the back to the tail, and the belly is white. The spotted may possibly be the tame; the last the wild lamas. The tail is short; the height is from four to four and a half feet; and the length, from the neck to the tail, six feet. In general the shape exactly

resembles that of the camel, only it wants the dorsal bunch.

The body of the pacos is covered with long and very fine wool, of the colour of dried roses, or a dull purple. The belly is white: in a tame state the colour varies. It is shaped like the former, but much less. The leg of one I saw was about the size of that of the buck.

In all languages two names are frequently bestowed on the same animal, one of which relates to its state of liberty, and the other to its domestic state. The wild boar and hog are the same animal, and these two names have no relation to any difference in the nature of the creatures, but to the condition of the species, one part of which is under the dominion of man, and the other independent. The same remark applies to the lamas and pacos, which were the only domestic animals of the ancient Americans: these names were appropriated to the animals in their domestic condition. [Before the arrival of the Spaniards the Indians of Peru had no domestic animals but the pacos and the huanacus.—*Hist. des Incas.*] The wild lama was called *huanacus* or *guanaco*, and the wild pacos *vicuna* or *vigogne*. I thought this remark necessary to prevent confusion. These animals are peculiar to the New World: they even love particular lands, beyond which they are never found. They appear to be confined to that chain of mountains which extends from New Spain to Terra Magellanica. They inhabit the most elevated regions of this globe, and seem to require a lighter air than that of our highest mountains.

It is singular, that though the lama and pacos are domestic in Peru, Mexico, and Chili, as the horse is in Europe, or the camel in Arabia, we have hardly any knowledge of them; and that, though the Spaniards have had the dominion of these vast countries for more than two centuries, none of their authors have given a complete history and exact description of these animals. It is alledged indeed, that they cannot be transported into Europe, nor even descend from their mountains, without perishing in a short time. But in Quito, Lima, and other towns, where men of letters reside, these animals might be drawn, described, and dissected. Herrera says very little concerning them; and Garcilasso only copies what has been mentioned by other writers. Acosta and Gregoire de Bolivar have collected the greatest number of facts regarding the natural dispositions of the lamas and the utility derived from them. But we know nothing of their internal structure, and of their time of gestation: we know not whether the lama and pacos be two distinct species, or whether they intermix together. These, and many other facts necessary to complete their history, are still objects of inquiry.

[P. Blas Vallera remarks, that the cattle of Peru are so mild that children use them as they please. There is a large and a smaller kind. The tamed huanacus (*lamas*) are of different colours, and the wild kind are all of a bay brown. These animals are about the height of a stag, and resemble the camel, only they want the bunch, and their neck is long and smooth. The cattle called *paco lamas* (*pacos*) are not nearly so much esteemed. The pacos are smaller than the lamas, and resemble the wild vicunnas. They are very delicate and slender; and their wool, though the quantity of it be small, is extremely fine. Acosta remarks, that this animal, as well as several others, is variously employed as a medicine by the natives.—*Hist. Incas.*]

Though they are said to perish when removed from their native country, it is certain, that after the conquest of Peru some lamas were transported to Europe. The animal mentioned by Gessner under the name of *allocamelus*, and of which he gives a figure, is a lama, that was brought alive from Peru to Holland in the year 1558. It is the same with that mentioned by Matthiolus, under the denomination of *elaphocamelus*, and which he has pretty accurately described. The pacos, and perhaps also the lama, have several times been brought to Spain, with a view to naturalize them. We ought, therefore, to be better informed concerning these animals, which might be rendered extremely useful to us; for it is probable that they would thrive on our Alps and Pyrennees as well as on the Cordeliers.

[No animal walks so securely upon rocks as the lama; because he adheres by means of a kind of spur on his feet.—*Coreal.*]

Peru, according to Gregoire de Bolivar, is the native country of the lamas: they have indeed been brought into other provinces, as New Spain, where however they are regarded more as objects of curiosity than of utility. But through the whole extent of Peru, from Potosi to Caraccas, these animals are extremely numerous. They constitute the sole wealth of the Indians, and contribute not a little to that of the Spaniards. The flesh of the lamas is good eating; their wool is excellent; and their whole lives are spent in transporting the commodities of the country. Their common load is a hundred and fifty pounds, and the strongest of them carry two hundred. They travel pretty long journeys in a country impassable to all other animals. They march slowly, and seldom accomplish more than four or five leagues a-day. Their gait is grave and firm. They descend precipitous ravins, and climb steep rocks, where even man himself dares not accompany them. They walk commonly four or five days on end, after which they wish to repose; and they spontaneously rest twenty-four or thirty hours before they resume their march. They are much employed in transporting the rich ores dug out of the mines of Potosi. Bolivar remarks, that in his time three hundred thousand of these animals were constantly occupied in this work.

Their growth is quick, and their life is not of long duration. At the age of three years they are in a condition

of producing, continue in full vigour till twelve, when they begin to decay; and at fifteen they are entirely useless. Their natural disposition seems to be modelled upon that of the Americans. They are mild and phlegmatic, and perform every thing by weight and measure. When they incline to rest a few minutes in their journey they bend their knees, and lower their bodies with the greatest precaution, to prevent their load from falling or being deranged; and whenever they hear their conductor's whistle they rise with the same precaution, and proceed on their journey. In going along they browse wherever they find herbage; but they never eat in the night, even though they have been sparingly fed during the day; for this time is spent in chewing their cud. When they sleep or ruminate they rest on their breast with their legs folded under their belly. When fatigued with travelling, if they once sink down under the load no blows can force them to rise. The last resource is to squeeze their testicles; but even that is often ineffectual. They remain obstinately where they lie; and if their master continues to abuse them, they despair and kill themselves, by alternately striking their heads from right to left upon the ground. They neither defend themselves with their feet nor their teeth, and they may be said to have no other arms but those of indignation. They spit in the face of those who insult them; and it is alledged, that the saliva which they throw out when enraged is so acrid as to raise blisters on the skin.

The lama is about four feet high, and his body, including the neck and head, is five or six feet in length. This animal has a well shaped head, large eyes, a pretty long muzzle, and thick lips, the superior one being divided, and the inferior somewhat pendulous. He nas neither cutting nor canine teeth in the upper jaw. His ears are four inches long, which he carries forward, erect, and moves at pleasure. The length of his tail, which is straight, slender, and a little raised, exceeds not eight inches. His feet are cloven, like those of the ox; but they are armed behind with a spur, which assists the animal in supporting itself upon rugged and difficult ground. The wool upon his back, crupper, and tail, is short, but very long upon the flank and belly. The lamas vary in colour; some of them are white, others black, and others of a mixed colour. Their dung resembles that of the goat. The penis of the male is slender and crooked in such a manner that he discharges his urine backward. The lamas are extremely lascivious, and yet they copulate with much difficulty. They seldom produce more than one at a time. The mother has only two teats, and the young one follows her the moment after it is brought forth. The flesh of the young ones is very good; but when old it is dry and hard. The flesh of the domestic is better than that of the wild lamas, and their wool is likewise much softer. Their skin is very compact: the Indians make shoes of it, and the Spaniards use it for harnesses. The food of these animals, which are so useful in the country that produces them, costs almost nothing. As they are cloven-footed, they require no shoes; and the thick wool with which they are covered renders saddles unnecessary. They have no need of corn or hay; green herbage, of which they take but small quantities, being sufficient for their nourishment. In drinking they are still more moderate. They quench their thirst with their saliva, which in this animal is more abundant than in any other.

[The head of the lama is proportionally small, and has some resemblance to that of the goat and sheep. The upper lip is divided like that of the hare: through this aperture they spit, to the distance of ten paces, upon those who disturb them; and if the saliva falls upon the face, it inflames or blisters the skin. They have a long neck, which bends downward where it springs from the body, like that of the camel, to which they would have a considerable resemblance, if they had a bunch on the back. Their height is about four feet and a half. They walk with their head erect, and with a pace so uniform, that even blows are incapable of making them move more quickly. They will not carry their loads during the night; but are obliged to be unloaded, in order to allow them to pasture. They eat little, and are never furnished with drink. Like the sheep they have cloven feet, and a spur above, which renders them sure-footed among the rocks. Their wool has a strong odour: it is long, spotted with white, gray, and red, and equally beautiful, though of an inferior quality, with that of the pacos.—*Frezier.*

The skin of the huanacus is hard: the Indians soften it with grease, and use it for soles to their shoes. But as this leather is not curried, it is soon wasted by the rain: the Spaniards make fine harnesses to their horses of the lama's hide: they employ these animals as the Indians do, in transporting their merchandise. Their common route is from Cozer to Potosi, which is about two hundred leagues, and their daily journey seldom exceeds three leagues; for they walk slowly, and if pushed beyond their ordinary pace they lie down, and it is impossible to raise them, even when the load is taken off their backs; so that they often die on the spot. When transporting goods they go in troops, and forty or fifty of them are always left unloaded in order instantly to relieve those which begin to be fatigued. The flesh of this animal is excellent; for it is both well tasted and wholesome, especially that of the young ones which exceed not four or five months old. Though these animals are very numerous, their food costs almost nothing; for after their journey they are unloaded and allowed to pasture in the fields. It is unnecesary to shoe or saddle them; for they are cloven-footed; and their wool prevents them from being incommoded by

their load, which their masters take care not to place on their back bone, otherwise it would kill them. The conductors of these animals never enter the towns, but sleep in tents, that their cattle may have an opportunity of pasturing during the night. They take four months in performing a journey from Cozer to Potosi, two in going, and as much in returning. At Cozer the best lamas sell at eighteen ducats a-piece, and the common sort at twelve or thirteen. The flesh of the wild huanacus is good, but inferior to that of the domestic kind.—*Hist. des Incas.*]

The huanacus, or lamas in a state of nature, are stronger, more active, and nimbler than the domestic kind. They run like the stag, and like the wild goat they climb the steepest rocks. Though in full possession of liberty they assemble in flocks, sometimes to the number of two or three hundred. When they perceive any person they look at him with astonishment, discovering neither fear nor pleasure: they then blow through their nostrils, neigh nearly like a horse, and fly off together to the tops of the mountains. They prefer the north side and the cold regions of the hills. They often climb and sojourn above the line of the snow. When travelling on ice, and covered with hoar frost, they are in better plight than in a temperate climate. In the Sierras, which are the most elevated parts of the Cordelieres, they are much more numerous, and have more strength and vigour than in the Lanos, which are lower. These wild lamas are hunted for the sake of their fleeces. It is difficult for the dogs to follow them; and if allowed time to gain the rocks, both hunters and dogs are obliged to abandon them. They seem to be as much afraid of the weight of the air as of heat; for they are never found in low lands: and as the chain of the Cordelieres, which is more than three thousand fathoms above the level of the sea at Peru, preserves nearly the same elevation from Chili to the Straits of Magellan the huanacus or wild lamas are very numerous throughout all that extent. But on the coast of New Spain, where these mountains sink considerably lower, no lamas are to be found except the domestic kind, which are brought thither.

[In the neighbourhood of Port Desire, at some distance from the Straits of Magellan, we found a number of those wild sheep which the Spaniards call *winaques*. Though very alert and timid we killed seven of them during our stay; and their wool seems to be much finer than that of any other animal. They go in flocks of five or seven hundred; and as soon as they perceive any person, they snort with their noses, and neigh like horses.—*Dampier.*

We saw at Tucuman, a province adjacent to Peru, large sheep, which were used as beasts of burden, and whose wool was as fine as silk.—*Woods Rogers.*]

The pacos are a species which may supply that of the lamas, as the ass might supply the place of the horse. They are smaller, and less proper for labour; but their fleeces are more useful. The long wool with which they are covered is an article of luxury as good and as precious as silk. The pacos, which are also called *alpaques*, when in a domestic state are often totally black, and sometimes of a brown colour mixed with yellow. The wild pacos have the colour of dried roses; and this natural colour is so fixed, that it suffers no change from the hand of the workman. Their wool makes excellent gloves, stockings, bed-clothes, and carpets. This commodity alone constitutes a valuable branch of commerce to the Spaniards. The beaver of Canada, the Calmuck sheep, and the Syrian goat, furnish not a finer hair: that of the pacos is as dear as silk. This animal possesses many things in common with the lama. It belongs exclusively to the same country; for it exists no where but on the Cordelieres. It has likewise the same dispositions, and nearly the same manners and temperament. As its wool, however, is longer and more bushy, it seems to be still less afraid of cold. It dwells more freely among the snows and ice of cold countries, and is extremely numerous in Terra Magellanica.

The pacos also resemble the lama in figure; but they are smaller, their legs are shorter, and their muzzle is more contracted. Their wool is of the colour of dried roses. They have no horns. They live and pasture on the most elevated parts of the mountains. Snow and ice seem rather to refresh than incommode them. They go in flocks, and run nimbly. They are very timid; and when they perceive any person they fly off, driving their young before them. The hunting of the pacos was rigorously prohibited by the ancient kings of Peru, because these animals do not multiply fast. At present they are much less numerous than at the time the Spaniards first took possession of that country. Their flesh is not so good as that of the huanacus; and they are sought after solely for the sake of their wool, and the bezoars which they produce. The manner of taking them shows their timidity, or perhaps their weakness. Several people assemble to chase these animals in some narrow defile, across which cords are stretched to the height of three or four feet, with pieces of linen or woollen cloth fixed upon them. When the pacos arrive, the motion of the pieces of cloth, produced by the wind, so terrifies them, that they dare not pass, but collect in large groups, which makes it an easy business to kill vast numbers of them. But if there happen to be any huanacus in the flock, as they are taller and less timid than the pacos, they spring over the cords; and when the example is once set, the pacos likewise leap and escape from the hunters.

With regard to the domestic pacos, they are employed, like the lamas, in carrying burdens; but they cannot bear as much weight, even in proportion to their size. They are still more subject to capricious obstinacy.

When once they lie down with their load, rather than rise they will suffer themselves to be cut in pieces. The Indians make no use of the milk of these animals; because they never yield more than is necessary to suckle their young. The great profits derived from their wool induced the Spaniards to endeavour to naturalize the pacos in Europe. They were transported into Spain; but the climate destroyed them. I am persuaded, however, as I formerly remarked, that these animals might succeed in our mountains, particularly in the Pyrennees. Those who brought them to Spain did not consider that even in Peru they subsist only in the cold region, or upon the tops of the highest mountains; that they are never found in low lands; that they die in warm countries; that, on the contrary, they are at present very numerous in the neighbourhood of the Straits of Magellan, where the cold is much more intense than in the south of Europe; and, consequently, that in order to preserve them they should be landed, not in Spain, but in Scotland, or even in Norway. The foot of the Pyrennees, Alps, &c. would probably answer the intention still better, where they could climb to the region which was most agreeable to their constitution. I have dwelt the longer on this subject, because I imagine that these animals would be a great acquisition to Europe, and would be productive of more real advantage than all the metals of the New World, which only load us with an useless weight, since a grain of gold or silver was formerly equal in value to what now constitutes an ounce of these metals.

[What advantage have we derived from the rich mines of Peru? To procure these metals millions of men have perished in the bowels of the earth, and their blood and labours have answered no other purpose than to load us with an unnecessary weight.]

Animals which feed upon herbs, and inhabit the high mountains of Asia and Africa, produce what are called the *oriental bezoars*, the virtues of which are so much extolled. Those of the European mountains, where the qualities of the plants are more temperate, produce only useless balls called *ægagropili*; and in South America all the animals that inhabit the mountains of the Torrid Zone furnish what are denominated *occidental bezoars*, which are still more solid, and have perhaps higher virtues than the *oriental*. The *vigogne*, or wild pacos, produces a great number, as well as the huanacus. These stones are likewise produced by the stags and roebucks on the mountains of New Spain. The lamas and pacos produce no fine bezoars, unless when in their natural wild state. The domestic kind afford only small, black bezoars, without any virtue. The best stones are of a dark green colour, and generally proceed from the wild pacos, particularly those which inhabit the highest parts of the mountains, and commonly pasture among the snows. Of these mountain pacos both the males and females produce bezoars. They hold the first rank after the oriental bezoars, and are in much higher estimation than those of New Spain, which proceed from stags, and are less efficacious than any of the other kinds.

THE TWO-TOED AND THREE-TOED SLOTHS.

THE sloths have no cutting teeth in either jaw; but they have canine teeth and grinders. The fore legs are much longer than the hind, and the claws are long. The two-toed sloth has a round head, short projecting nose, ears like the human, lying flat on the head, two long claws on the fore feet, and three on the hind. The hair on the body is long and rough; in some parts curled and woolly, in some of a pale red above, cinereous below, and in others of a yellowish white below, and a cinereous brown above. The length of that in the British museum is eleven inches; I believe it is a young one: it has no tail.

The three-toed sloth has a blunt black nose, a little lengthened, very small external ears, and eyes small, black, and heavy. From the corner of each eye there is a dusky line. The colour of the face and throat is a dirty white. The hair on the limbs and body is long, very uneven, and of a cinereous brown colour. The tail is short, being a mere stump. The legs are thick, long, and awkwardly placed. The face is naked. There are three toes. There are three toes and three very long claws on each foot. The length of that in the British museum is twelve inches; but it grows to the size of a middle sized fox.

These two animals have been denominated *sloths* on account of the slowness of their movements, and the difficulty with which they walk. Though they resemble each other in many respects, they differ, both externally and internally, by characters so marked, that it is impossible not to recognise them as very distinct species. The unau, or two-toed sloth, has no tail, and only two claws on the fore feet. The ai, or three-toed sloth, has

a tail, and three claws on all the feet. The muzzle of the former is longer, the front more elevated, and the ears more apparent than those of the latter. Their hair is also very different. The structure and situation of some parts of their viscera are likewise different. But the most remarkable distinction is derived from this singular circumstance, that the unau has forty-six ribs, and the ai only twenty-eight, which shows them to be species very remote from each other. This number of ribs, in the body of an animal so short, is an excess or error of Nature; for no animal, however large, has such a number of ribs: the elephant has only forty, the horse thirty-six, the badger thirty, the dog twenty-six, man twenty-four, &c. This difference in the structure of the sloths indicates a greater distance between these two species than between the dog and cat, which have both the same number of ribs; for external differences are nothing when compared to those which are internal: the former may be regarded as causes, and the latter as effects only. The interior frame of animated beings is the foundation of Nature's plan; it is the constituent form, and the origin of all figure: but the external parts are only the surface or drapery. How often have we not found, in the course of our comparative examination of animals, that a very different external appearance covered internal parts perfectly similar; and that, on the contrary, the slightest internal distinction produced great external differences, and changed the natural dispositions, powers, and qualities of the animal? How many animals are armed, covered, and adorned with excrescent parts, whose external structure corresponds exactly with others which are totally deprived of such appendages? But this is not a proper place for such nice disquisitions. We shall only remark, that, in proportion as Nature is vivacious, active, and exalted in the monkey kind, she is slow, restrained, and fettered in the sloths. From a defect in their conformation, the misery of these animals is not more conspicuous than their slowness. They have no cutting teeth; the eyes are obscured with hair; the chops are heavy and thick; the hair is flat, and resembles withered herbs; the thighs are ill jointed to the haunches; the legs are too short, ill turned, and terminated still worse: their feet have no soles, and no toes which move separately, but only two or three claws disproportionally long, and bended downward, which move together, and are more hurtful to their walking, than advantageous in assisting them to climb. Slowness, habitual pain, and stupidity, are the results of this strange conformation. The sloths have no weapons either offensive or defensive. They are furnished with no means of safety; for they can neither fly nor dig the earth. Confined to a small space, or to the tree under which they are brought forth, they are prisoners in the midst of space, and cannot move the length of one fathom in an hour. They drag themselves up a tree with much labour and pain. Their cry and interrupted accents they dare only utter during the night. All these circumstances announce the misery of the sloths, and recall to our minds those defective monsters, those imperfect sketches of Nature, which, being hardly endowed with the faculty of existence, could not subsist for any length of time, and have accordingly been struck out of the list of beings. If the regions inhabited by the sloths were not desert, but had been long occupied by men and the larger animals, these species would never have descended to our times: they would have been annihilated, as must happen in some future period. We formerly remarked, that every thing that possibly could be, really did exist; of which the sloths are a striking example.

Why should not some animals be created for misery, since, in the human species, the greatest number of individuals are devoted to pain from the moment of their existence? Evil, it is true, proceeds more from ourselves than from nature. For a single person who is unhappy, because he was born feeble or deformed, there are millions rendered miserable by the oppression of their superiors. The animals, in general are more happy, because the species have nothing to fear from individuals: to them there is but one source of evil; to man there are two. Moral evil, of which he himself is the fountain, has accumulated into an immense ocean, which covers and afflicts the whole surface of the earth. Physical evil, on the contrary, is restrained within very narrow bounds: it seldom appears alone; for it is always accompanied with an equal, if not a superior good. Can happiness be denied to animals, when they enjoy freedom, have the faculty of procuring subsistence with ease, and possess more health, and organs capable of affording greater pleasure than those of the human species? Now, the generality of animals are most liberally endowed with all these sources of enjoyment. The species of sloths are perhaps the only creatures who exhibit to us the picture of innate misery.

Let us take a closer view of the condition of these creatures. By the want of teeth, they can neither seize prey, nor feed upon flesh or herbage. Reduced to the necessity of living upon leaves and wild fruits, they consume much time in trailing their bodies to the foot of a tree, and still more in climbing to the branches; and, during this slow and melancholy exercise, which sometimes lasts several days, they are obliged to suffer the most pressing hunger. When arrived upon a tree, they never descend. They cling to the branches, and devour successively the leaves of every twig. They pass several weeks in this situation, without receiving any drink. When they have rendered the tree entirely naked, they still remain; because they cannot descend. In fine, when the pressure of hunger becomes superior to the dread of danger or death, being unable to descend,

they allow themselves to tumble down like an inanimated mass; for their stiff and inactive limbs have not time to extend themselves in order to break the fall.

When on the ground, they are at the mercy of all their enemies. As their flesh is not absolutely bad, both men and rapacious animals go in quest of these animals. It appears that they do not multiply fast, or, at least, if they produce frequently, it must be in small numbers at a time; for they have only two paps. Every circumstance, therefore, concurs to destroy them; and it is extremely difficult for the species to support itself. But, though slow, awkward, and almost incapable of motion, they are obstinate, strong, and tenacious of life. They can live very long without victuals of any kind. They are covered with thick, dry hair; and, being incapable of exercise, they lose little by perspiration; and, though their food be meager, they fatten by repose. Though they have no horns nor hoofs, nor cutting teeth in the under jaw, yet they belong to the ruminating tribes, and have several stomachs. Hence the quality of their food may be compensated by the quantity they take at a time. What is still more singular, instead of very long intestines, like other ruminating animals, their guts are very short and small, like those of the carnivorous kind. The sloths are unquestionably ruminating animals: they have four stomachs; and yet they want every other character, both internal and external, which generally belongs to animals of this class. There is still another singularity in the conformation of the sloths: instead of three distinct apertures for the discharge of urine and excrements, and for the purposes of generation, these animals have but one, which terminates in a common canal, as in birds.

Moreover, if the misery resulting from a defect of sentiment be not the worst of all, the pain endured by the sloths, though very apparent, seems not to be real; for their sensations appear to be blunt. Their calamitous air, their dull aspect, and their reception of blows without emotion, announce their extreme insensibility. This bluntness of sensation is farther demonstrated, by their not dying instantly when their hearts and bowels are entirely cut out. Piso, who made this cruel experiment, tells us, that the heart, after being separated from the body, beat in a lively manner for half an hour; and that the animal continued to contract its legs slowly, as commonly happens during sleep. From these facts, this quadruped seems to approach not only the turtle, but the other reptiles which have no distinct centre of sensation. All these beings may be said to be miserable, but not unhappy: nature, in her productions, always appears more in the character of a parent than of a stepmother.

These two animals are peculiar to the southern regions of the New Continent, and are no where to be found in the Old. We formerly remarked, that the editor of Seba's cabinet was deceived when he calls the two-toed sloth, or unau, the *sloth of Ceylon*. This error, which has been adopted by Klein, Linnæus, and Brisson, is now more evident than it was formerly. The Marquis de Montmirail has a live unau, which was transmitted to him from Surinam: those we have in the Royal Cabinet were brought from the same place and from Guiana; and I am persuaded that both species exist through the whole deserts of America, from Brasil to Mexico. But, as they have never frequented the northern regions, they could not pass from the one Continent to the other. If these animals have sometimes been seen in the East Indies, or on the coast of Africa, it is certain that they must have been transported thither. They cannot endure cold; and they likewise dread rain. The alternation of moisture and driness changes their fur, which has more the appearance of ill dressed hemp than of wool or hair.

I shall finish this article with some observations communicated to me by the Marquis de Montmirail, concerning an unau, or two-toed sloth, which he fed three years in his menagery: 'The hair of the unau is much 'softer than that of the ai. All that has been said by 'travellers concerning the excessive slowness of the 'sloths should, probably, be applied only to the ai, or 'three-toed species. The unau, though very heavy, and 'of an extremely awkward gait, mounted and descended 'the highest tree several times in a day. It is in the 'evening and during the night that he was most active, 'which made me suspect that he saw very ill in the day, 'and that his eyes were of no use to him but in the 'dark. I purchased this animal at Amsterdam. It was 'fed with sea biscuit; and I was told, that, during the 'verdure of the trees, it would require nothing but 'leaves. We gave him leaves, which he eat freely, 'when they were tender; but, as soon as they began to 'dry, or were pierced by caterpillars, he refused them. 'During the three years that I kept him alive in my 'menagery, his ordinary food was bread, apples, and 'roots; and his drink was milk. He always laid hold, 'though with difficulty, of what he wanted to eat, with 'his fore paws; and the difficulty increased in proportion to the largeness of the morsel. He seldom cried; 'his cry is short, and he never repeats it twice, without 'a considerable interval. This cry, though plaintive, 'has no resemblance to that of the ai, if it be true that 'ai is the sound of that animal's voice. The most natural situation of the unau, and which he prefers to all 'others, is hanging on a branch, with his body turned 'downward. He sometimes sleeps in this position, his 'fore paws being fixed to the same point, and his body 'forming an arch. The strength of his muscles is incredible; but it becomes useless to him when he 'walks; for his motion is constrained and wavering. 'This structure alone seems to be the cause of the

'animal's slowness, which, besides, has no violent appe-
'tites, and does not recognise those who take care of
'him.'

SUPPLEMENT.

M. de la Borde remarks, that there are two species of these animals in Cayenne, the one called the *bashful sloth*, and the other the *sheep sloth*. The latter is twice as long as the former, and of the same thickness. He has long, bushy, whitish hair, and weighs about twenty-five pounds. He throws himself down upon men from the tops of trees, but in a manner so sluggish that it is easy to avoid him. He feeds during the day as well as the night.

'The bashful sloth,' M. de la Borde remarks, 'has
'black spots on his body, weighs twelve pounds, keeps
'always on trees, and eats the leaves of the Surinam
'fig-tree, which are said to be poisonous. The bowels
'of this sloth poison dogs, and yet the flesh is good to
'eat; but its use is confined to the common people.

'Both species produce only a single young, which
'they always carry on their back. It is probable, though
'I am not certain, that the females bring forth on trees.
'They feed on the leaves of the Brasilian plumb-tree
'and of the Surinam fig. The two species are equally
'common; but they are not frequent in the environs
'of Cayenne. They sometimes suspend themselves by
'their claws on branches of trees which hang over the
'rivers; and when in this situation it is easy to cut the
'branch and make them fall into the water; for they
'never quit their hold.

'When ascending a tree, this animal carelessly
'stretches out one of its fore pats, and fixes its long
'claw as high as it can reach. It then heavily raises its
'body, gradually fixes the other pat, and in this manner
'continues to climb. All these movements are incre-
'dibly slow and languid. When kept in houses they
'always climb upon some post or door, and never choose
'to rest on the ground. If a stick is held out to them
'when on the ground, they lay hold of it and mount to
'its top, where they firmly adhere with their fore paws,
'and embrace the stick with their whole body. They
'have a weak plaintive cry, which is heard at no great
'distance.'

From this passage it is obvious that the sheep-sloth is the same with what we have called *unau*, or the three-toed sloth; and that the bashful sloth is the *ai*, or two-toed species.

M. Vosmaer, an able naturalist, and superintendant of the Prince of Orange's cabinet, has criticised two assertions in my history of these animals. He remarks, 'that we ought to reject the relation of M. de Buffon 'when he tells us that the sloths are unable to de-
'scend from a tree, but allow themselves to fall down
'like blocks.'

I advanced this fact on the authority of eye-witnesses, who assured me, that they had sometimes seen the animal fall down at their feet. The fact is farther supported by the testimony of M. de la Borde. What I have said on this subject, therefore, ought by no means to be rejected.

The second assertion is not equally well founded. I willingly acknowledge my mistake when I said that the sloths had no teeth, and I thank M. Vosmaer for correcting this error.

THE SURIKATE, OR FOUR-TOED WEASEL.

THE four-toed weasel, with the upper jaw much longer than the lower, and very moveable and pliant. The ears are rounded; the hair pretty long, hard, and upright, varied with black and white; the points black. It has only four toes on each foot, which is an exception to the weasel kind. The tail is taper. The length of the animal, from nose to tail, is about one foot, and that of the tail six inches.

This animal was purchased in Holland under the name of *surikate*. It is a native of Surinam, and other provinces of South America. [Mr. Pennant remarks, that M. de Buffon is the only person who has described this animal, but that he seems to have been deceived with regard to the place of its nativity. Instead of South America, Mr. Pennant says, that it inhabits the Cape of Good Hope and the island of Java.] We fed it for some time; and afterwards M. de Seve, who has drawn with equal skill and attention the animals published in this work, having kept it alive during several months, communicated to me the remarks he had made with regard to its natural habits and dispositions. It is a handsome, active, and dextrous animal, sometimes walking on end, and frequently sitting upright, with its fore feet hanging down, his head erect, and moving on the neck as upon a pivot. He always assumed this attitude when he came near the fire to warm himself. He is not so large as a rabbit, and pretty much resembles the ichneumon, both in size and hair, only it is rougher, and

the tail is not so long. But by the prominency of the upper part of the muzzle, he makes a nearer approach to the coati or Brasilian weasel than to any other animal. He has also a character which is peculiar to him and the hyæna; for they are the only animals which have four toes on all their feet.

At first we fed this surikate with milk, because he was very young: but his taste for flesh soon appeared. He eat raw meat, and particularly the flesh of chickens, with great avidity. He likewise endeavoured to seize young animals. A young rabbit, which lived in the same house, would have fallen a prey to him, if he had not been prevented from making the attack. He was fond of fish, and still fonder of eggs. I have seen him carry off with his two paws eggs which had been put in the water to be boiled. He refused fruits, and even bread, unless it was mashed. Like the squirrel, he employed his fore paws to convey his victuals to his mouth. In drinking he lapped like a dog, and never drank water but when it was warm. His ordinary drink was his own urine, though it had a very strong odour. He frolicked with the cats, and always innocently. He did no harm to the children, and never bit any person but the master of the house, to whom he had taken an aversion. He never gnawed with his teeth, but often injured the plaster and furniture by scratching with his claws. He was so well tamed that he knew his own name. He went through the whole house, and returned whenever he was called. He uttered two kinds of sounds. When he was tired by being alone, or heard any unusual noise, he barked like a young dog; and when he was caressed, or felt any pleasant emotion, he made a noise as brisk and striking as a small rattle rapidly turned round. This animal was a female, and appeared to be frequently in season, notwithstanding the coldness of the climate, which, though every thing was done to cherish and keep her warm, she could support during one winter only.

SUPPLEMENT.

We formerly remarked that the surikate did no injury to children; and that it never bit any person but adults, and among others the master of the family, against whom it had taken an aversion. I since learned that it never attacked either the mother or the children of his family, but that it bit a number of other persons of both sexes. M. de Seve remarked, that it was induced to bite by some particular odour. When laid hold of, the cartilage at the end of its nose curled up when it smelled, and according to the odour received, it either bit or did not bite. This experiment was tried upon a number of people; and it is singular whenever it bit one person it always continued to bite him. Some people were so disagreeable to him, that he endeavoured to make his escape in order to bite them; and when he could not lay hold of the legs, he darted upon their shoes or petticoats. He even used several artifices to come near those whom he wished to bite.

M. Vosmaer, in his description of a flying squirrel, makes the following pertinent remarks.

'M. de Buffon,' says M. Vosmaer, 'has probably been 'deceived both with regard to the name and the native 'country of the surikate, which was last summer trans-'mitted by M. Tulbagh to the Prince of Orange. It 'belongs not to America but to Africa. This small 'animal, a male and a female of which were directed to 'me, but the female died in the passage, was unknown 'to Kolbe, or at least is not mentioned by him, and ap-'pears to be found far up the country only: this infer-'ence may be drawn from the governor's letter, which 'I received at the same time, and where he makes the 'following remark: "I send by the Captain two small 'animals, a male and a female, to which I can neither 'give a name, nor refer them to any other species; be-'cause they were for the first time brought from the 'remote deserts and stony mountains of this vast coun-'try. They are very mild and gentle. They feed upon 'fresh meat, either boiled or raw, eggs, and ants. I hope 'they will arrive in life; for I imagine they were never 'hitherto seen in Europe."'

The evidence of M. Tulbagh is positive, and M. de Vosmaer's remark is just; for though I had this animal alive for a long time, I received its name and country from no better authority than an animal merchant, who told me he had purchased it in Holland under the name of *surikate*, and that it came from Surinam. We are now certain that it is neither found in Surinam nor in the other provinces of South America, but in the mountains of Africa above the Cape of Good Hope; and as to the name it is of little moment: it can be changed when we receive better information.

THE TARSIER, OR WOOLLY JERBOA.

THE jerboa with a sharp pointed nose, long, erect, naked, transparent ears, large eyes, two cutting teeth in each jaw, and, what is peculiar to this species, two canine teeth in each. It has five long slender fingers on each foot, resembling those of a monkey. The fore legs are moderately long. The hind legs are of a very remarkable

length, especially the second bone; that next the foot is slender and naked. The tail is exceedingly long and slender. The hair on the body is long, soft, and woolly. The head is ash-coloured, the rest of the body tawny mixed with ash-colour. It is larger than a common mouse.

We accidentally procured this animal from a person who could neither tell its name, nor from whence it came. It is remarkable for the excessive length of its hind legs. The bones of the feet, and particularly those which compose the upper part of the *tarsus*, are prodigiously long; and it is from this distinctive character that we have derived the name of the animal. The tarsier, however, is not the only quadruped whose hind legs are constructed in this manner. The tarsus of the Egyptian jerboa is still longer. Hence the appellation of *tarsier* is only precarious, and ought to be changed as soon as we learn the name which the animal receives in the country where it is produced. The jerboa is found in Egypt, Barbary, and the East Indies. I at first imagined that the tarsier might belong to the same countries, on account of its resemblance to the jerboa. Both these animals are of the size of a middling rat. The hind legs of both are excessively long, and those before very short. In both the tail is of a prodigious length, and garnished towards the extremity with long hairs. Both have very large eyes, and erect, large, open ears. In both the inferior parts of the hind legs are naked, while the rest of the body is covered with hair. As these animals possess in common such peculiar characters, it might be presumed that they were neighbouring species, or at least species produced by the same climate and country. From a comparison of their other parts, however, this is rendered extremely doubtful. The tarsier has five toes on all his feet, and may be said to have four hands; for his five toes are very long, and well separated. The thumbs of the hind feet terminate in a flat nail; and though the nails of the other toes be pointed, they are so short and small, that the animal can use its fore feet in the same manner as hands. The jerboa, on the contrary, has only four toes, and four long crooked claws on the fore feet; and instead of a thumb it has only a tubercle without any nail. But what removes these animals to a greater distance, the jerboa has but three toes, or three large claws, on the hind feet. This distinction is too great for animals nearly allied in species; and it is not impossible that they belong to very distant climates; for the tarsier, by his small size, his four hands, long toes, and small claws, and his long tail and feet, seems to make a near approach to the murine, Mexican, and Surinam opossums. But we here throw out our doubts only; and shall be highly obliged to any person who can ascertain or remove them, by pointing out the real country and name of this animal.

THE PHALANGER, OR SURINAM OPOSSUM.

OPOSSUM with a thick nose, short ears covered with hair, eight cutting teeth in the upper jaw, and two in the lower. The hair on the upper part of the body is reddish, mixed with light ash-colour and yellow. The hind part of the head, and middle of the back, are marked with a black line. The throat, belly, legs, and part of the tail, are of a dirty yellowish white. The rest of the tail is brown and yellow. The body of the female is marked with white. The first and second toes of the hind feet are closely united. The claws are large. The thumb on the hind feet is distinct. The bottom of the tail is covered with hair for near two inches and a half; the rest of it is naked. The length of the animal, from nose to tail, is near nine inches, and that of the tail ten.

The male and female phalanger, which were transmitted to us under the appellation of *Surinam rats*, are much less allied to the rats than the animals whose history we have given under the name of *marmose*, or murine opossum, and *cayopollin*, or Mexican opossum. We have rejected the denomination of *Surinam rats*, because it is both compounded and ill applied. As the animal is mentioned by no traveller or naturalist, we have called it *phalanger*, because its phalanges are very singularly constructed, and because the two first toes of the fore feet are attached to each other as far as the end of the last phalanx. The thumb is separated from the other toes, and has no claw. This last character is not peculiar; for the Virginian and murine opossums have the same kind of thumb, but none of them have united phalanges.

These animals seem to vary among themselves, as appears from the figures of the male and female. They are of the size of a small rabbit, or of a very large rat, and are remarkable for the excessive length of their tail, the prolongation of their muzzle, and the form of their teeth, which alone would be sufficient to distinguish them from the murine and Virginian opossums, the rats, and every other species of quadrupeds.

THE JAVELIN BAT.

JAVELIN bat, with large pointed ears, and an erect membrane at the end of the nose, in the form of the head of an ancient javelin, having on each side two upright processes. It has no tail; the fur is cinereous; and it is of the size of a common bat.

Of the various bats which were unknown, we denominated some by names derived from foreign languages, and others by appellations drawn from their most striking characters. The animal now under consideration we have called the *javelin bat*, because it has a membrane on its nose nearly of the shape of an ancient javelin or spear. Though this character be sufficient to distinguish it from all other bats, we may add, that it has almost no tail; that it is nearly of the same colour and size with the common bat; but that instead of having six cutting teeth in the under jaw, like most of the other species, it has only four. This bat, which is very common in America, does not exist in Europe.

In Senegal there is another bat with a membrane on its nose; but this membrane, instead of resembling a javelin or a horse-shoe, as in this and a former species, has the figure of an oval leaf. These three bats, as they belong to different climates, are not simple varieties but distinct species. M. Daubenton has described this bat under the name of the *leaf bat*.

The bats, which are already greatly allied to the birds by their flying, their wings, and the strength of their pectoral muscles, seem to make a still nearer approach by these crests or membranes on their face. These redundant parts, which at first sight appear to be superfluous deformities, are the real characters, the visible shades, by which nature has connected these flying quadrupeds to the birds; for most of the latter have membranes and crests round their bills and heads, which seem to be equally superfluous with those of the bats.

SUPPLEMENT.

M. Pallas, who sent us descriptions of two bats, informs us, that the javelin bat, formerly described, should not be confounded with the bat described by Seba under the appellation of the common American bat. M. Pallas, after comparing the two, assures us, that they are very different species. Our acknowledgments are due to M. Pallas for pointing out this mistake.

He then gives a description of one of these bats, which is a native of India. He calls it *cephalotte*, because its head is very large in proportion to its body. The neck is also more distinct, because it is not so thickly covered with hair. The following is an extract from M. Pallas's description.

'This bat, hitherto unknown to the naturalists, is 'found in the Molucca islands, from which two females 'were sent to M. Schlosser at Amsterdam. The female 'seems to produce but one young. This conjecture is 'founded on M. Pallas's dissection of one of these fe-'males, in which he found one fœtus only.

'This bat,' continues M. Pallas, 'differs from all 'others in the teeth, which have some resemblance to 'those of the mouse, or even of the hedgehog, and ap-'pear to be rather destined for cutting fruits than for 'devouring prey. The canine teeth of the upper jaw 'are separated by two small teeth. In the under jaw 'these small teeth are wanting, and the two canine 'teeth of the same jaw are like the cutting teeth of a 'mouse.'

'The tail of the cephalotte bat,' says M. Pallas, 'is 'not long, and is situated under the membrane between 'the two thighs. The figure of the nostrils distin-'guishes it from every other bat. The form of the pupil 'likewise differs from that of every other bat. The 'breast is broad, and has a greater resemblance to the 'breast of a bird than any other species. This animal 'is about 3¾ inches long, and its wings extend above a 'foot in length.'

The second species of bats described by M. Pallas under the denomination of *vespertilio soricinus*, or shrew bat, has no tail, and carries a leaf or membrane on its nose. It is the smallest of those kinds which want the tail, being only about two inches long. It is equally common in the warmest regions of America, the Caribbee islands, and Surinam. The muzzle of this bat is longer and more slender than in the other kinds. The tongue is remarkable both for its length and structure. The male and female hardly differ but in the organs of generation.

THE COQUALLIN, OR VARIED SQUIRREL.

SQUIRREL with plain ears; the upper part of the body varied with black, white and brown, and the belly tawny. It is twice the size of the common squirrel.

This animal, which was sent to me from America under the name of the *orange squirrel*, I recognised to be the same with that which Fernandez calls *qualucallotquapachli*, or *coztiocotoquallin*. But as these Mexican words are difficult to pronounce, I have abridged the last into *coquallin*. It is not a squirrel, though it resembles that animal in figure, and in bushiness of tail; for it differs from the squirrel not only in several external characters, but in its dispositions and manners.

The coquallin is much larger than the squirrel: it is a handsome animal, and its colours are very remarkable. The belly is of a fine yellow colour, and the head as well as the body are variegated with white, black, brown, and orange. Like the squirrel it covers itself with its tail; but it has no pencils of hairs on the tips of the ears; it mounts not upon trees; and it dwells, like the ground squirrel, in holes and under the roots of trees, where it brings forth its young. It lays up grain and fruits for nourishment during the winter. It is timid and crafty, and so wild that it can never be tamed.

The coquallin seems to be peculiar to the South American regions. The white and orange squirrels of the East Indies are much smaller, and their colours are uniform. They are genuine squirrels, which dwell and bring forth upon trees. But the coquallin and ground squirrel of America, live under the earth like rabbits, and have no relation to squirrels but what arises from their figure.

THE HAMSTER, OR GERMAN MARMOT.

MARMOT with large rounded ears, and full black eyes. The colour of the head and back is a reddish brown, and that of the cheeks white. Beneath each ear there is a white spot, another on each shoulder, and a third near the hind legs. The breast, upper part of the fore legs, and the belly, are black. The tail is short and almost naked. It has four toes and a fifth claw on the fore feet, and five toes behind. The length of the body is about nine inches, and that of the tail three.

The hamster is the most famous, as well as the most destructive of all rats. We omitted its history when treating of the other rats, because at that time we had not an opportunity of seeing and examining the animal. For the knowledge we have now acquired of it, we are obliged to the Marquis de Montmirail and M. de Waitz, who sent us two live hamsters, accompanied with an instructive memoir concerning their manners and dispositions. We fed one of these animals during several months, in order to examine it attentively, and afterwards dissected it, with a view to compare its internal structure with that of other rats. In its anterior parts it has a greater resemblance to the water rat than to any other animal. It resembles him still more in the smallness of its eyes and the fineness of its skin. But the tail, instead of being long, is shorter than that of the compagnol or short-tailed mouse, which, as formerly remarked, has a great similarity to the water rat in its internal conformation. The hamster seems to be, with regard to the short-tailed field mouse, what the surmulot or Norway rat is to the long-tailed field mouse. All these animals live under ground, and appear to be animated with the same instinct. They have nearly the same manners, and particularly that of collecting magazines of grain in their holes. We shall not therefore enlarge so much on the resemblances in figure and dispositions, as upon the differences which distinguish the hamster from all the other rats of which we have formerly treated.

Agricola is the first writer from whom any genuine information can be derived concerning the hamster; to which Fabricius adds a few facts. But Schwenckfeld has done more than all the other authors put together. He dissected the hamster, and gave a description of it, which corresponds almost in every article with ours; yet he is hardly quoted by our more modern naturalists, who content themselves with copying Gessner. In justice to this author we have inserted his remarks entire; and when to these we add the observations of M. de Waitz, the history of this animal will be complete.

'The habitations of the hamster are differently con-
'structed, according to their sex, age, and the quality of
'the ground. The house of the male has an oblique
'passage, at the mouth of which there is a considerable
'heap of earth. At a distance from this oblique passage

'there is a hole which descends perpendicularly into the 'chambers of the lodging. No earth appears near this 'hole; which renders it probable that the oblique pas-'sage is dug from without, and that the perpendicular 'hole is begun from below, and continued upward.

'The house of the female has likewise an oblique 'passage, and at the same time two, three, and not un-'frequently eight perpendicular holes, in order to allow 'her young to go out and in at pleasure. The male and 'female have each a different dwelling, and the female 'makes her's deeper than the male.

'At the distance of a foot or two on each side of the 'perpendicular holes the hamsters of both sexes, accord-'ing to their age and their number of young, dig one, 'two, three, and sometimes four cavities in the form of 'vaults, both above and below, which are more or less 'capacious in proportion to the quantity of their provi-'sions.

'The perpendicular hole is the common passage: the 'oblique one is made for the purpose of carrying out 'the earth. As the declivity of this oblique passage is 'more gentle in one cavity than in another, it may like-'wise promote a circulation of air in those subterraneous 'habitations. In the cavern where the female brings 'forth her young there is no magazine of grain but a 'nest of straw and herbs. The depth of the caverns is 'various. A young hamster, in the first year, makes his 'cavern not above a foot deep; but the old ones fre-'quently dig to the depth of four or five feet. The 'whole habitation, including the passages and caverns, 'is sometimes from eight to ten feet in diameter.

'These animals provide their magazines with dry 'clean grain, corn in the ear, peas, and beans in their 'pods, and afterwards carry out the husks and pods by 'the oblique passages. In transporting their provisions 'they use the pouches in their cheeks, each of which 'will hold a quarter of an English pint.

'The hamster begins to lay up provisions about the 'end of August. When his magazines are filled he 'covers them, and carefully shuts up all the avenues 'with earth, which prevents his retreat from being easily 'discovered, and it is only to be recognised by the heap 'of earth near the oblique passage mentioned above; 'after which the perpendicular holes must be investi-'gated. The most common method of seizing these 'animals is to dig them out, which is a laborious task, 'on account of the extent and depth of their holes. A 'person, however, who accustoms himself to this species 'of hunting, fails not to profit by it; for in autumn, 'which is the proper season, he generally finds in each 'habitation, beside the fur of the animal, two bushels 'of good grain. The hamsters produce twice or thrice 'in a year, and bring forth five or six, and often more, 'at each litter. In some years they appear in prodigious 'numbers, and in others hardly any of them are to be 'seen. It is in moist years that they multiply so greatly; 'and this numerous multiplication occasions a dearth, 'by the general devastation they make among the corn.

'At the age of six weeks or two months the hamsters 'begin to dig their habitations; but they neither couple 'nor produce during the first year.

'The polecats destroy great numbers of the hamsters, 'and take possession of their holes.

'The hamsters are commonly brown on the back and 'white on the belly. Some of them, however, are gray; 'and this difference may be the effect of advanced age. 'Some of them are also totally black.'

Like the mulet, or long-tailed field mouse, the hamsters totally destroy each other. Of two kept in a cage the female killed the male in one night, and after cutting the muscles which fix the jaws to each other, devoured a part of the intestines. They produce several times in the year, and are so destructive, that in the states of Germany a price is set upon their heads. They are so numerous in that part of the continent that their fur is a considerable article of commerce.

All these facts, which we have extracted from the memoir of M. Waitz, and the remarks of M. de Montmirail, appear to be certain, and correspond with our other sources of information concerning the hamsters. But it is not equally certain, as mentioned in the same memoir, that they remain in a torpid state during the winter, and revive in the spring. The hamster which we kept in an apartment without fire, and where the cold frequently congealed water, never became torpid, but moved about and eat its ordinary food. But several kinds of dormice, which were likewise in our possession, became torpid in a much smaller degree of cold. Hence the hamster neither approaches the dormice nor marmot by character; and some of our naturalists have improperly called it the *marmot of Strasburg*, though it sleeps not like the marmot, nor is found in the neighbourhood of Strasburg.

SUPPLEMENT.

In the *Gazette de Litterature, of the* 13th of September, 1774, we find the following observations concerning the hamster, extracted from a German publication by M. Sulzer.

'The corn-rat, in German *hamster*, cannot be more 'commodiously described than at Gotha, where in one 'year 11,574 skins of it, in another, 54,429, and in a 'third, 80,139, have been brought to the town house. In 'general this animal inhabits temperate countries. When 'irritated its heart beats 180 times in a minute. The 'weight of the body is to that of the brain as 1 to 193.

'These animals lay up magazines which often con-

'sist of twelve pounds of grain. In winter, the female 'sinks very deep in the earth. The male is a bold ani- 'mal, and defends himself against dogs, cats, and men. 'He is naturally quarrelsome, agrees not with his own 'species, and sometimes, in a transport of fury, slays his 'own family. He devours the feeble individuals of his 'species, as well as mice and birds; and yet he feeds 'upon all kinds of herbs, fruits, and seeds. He drinks 'little; and the female remains longer in her winter 'retreat than the male. The former goes four weeks 'with young, and often produces six at a litter. In 'a few months, the females become fertile. The rat 'called *iltis* kills the hamster.' [The *iltis* is the polecat, and not a rat, as this author alledges.]

'When this animal is in a torpid state, neither respi- 'ration, nor any kind of feeling, can be perceived. The 'heart, however, beats fifteen times in a minute, which 'is discovered by opening the chest. The blood con- 'tinues to be fluid, and the intestines are not irritable. 'Even an electrical shock does not awake him: in the 'open air, he is never reduced to a torpid state.'

M. Sulzer mentions the gradual manner in which this animal recovers his vigour and activity.

'The utility of the hamster is confined to the destruc- 'tion of mice; but he himself is much more mis- 'chievous.'

We wish that M. Sulzer had marked the precise degree of cold, or want of air, which renders these animals torpid; for we still maintain, what was formerly remarked, that a hamster confined in a cage, and in a room where water froze, was not reduced to a torpid state during the winter 1763. This fact will receive additional confirmation from the following observations of M. Allamand, which he has published at the end of the Dutch edition of my work.

Addition to the history of the Hamster, by M. Allamand.

The hamster is a quadruped of the mouse kind, which sleeps during the winter, like the marmots. The legs and neck are short; the head is thickish; and the mouth is garnished on each side with whiskers. The ears are large and almost naked. The tail is short, and one half of it naked. The eyes are round and prominent. The colour of the hair is a mixture of red, yellow, white, and black. These characters exhibit not the most alluring picture; and the manners of the animal are still more disgusting. He has no love but for himself, and possesses not a single social quality. He attacks and devours every animal he is capable of conquering, not excepting his own species. Even the instinct which draws him to the other sex, lasts only a few hours; at the end of which the female would not meet with a better fate, if she did not take the precaution of avoiding, or of killing him first. To these odious qualities, however, Nature has joined others, which, without rendering him more amiable, make him deserve a distinguished rank in the history of animals. He belongs to the small number of those which pass the winter in a torpid state, and he is the only European animal that is provided with cheek-pouches. His address in making a subterraneous abode, and the industry with which he lays up provisions, merit the attention of the curious.

The hamster inhabits not all soils or climates indifferently. He is neither found in very warm nor in very cold countries. As he lives upon grains, and dwells under the earth, stony, sandy, or argillaceous soils are as inconvenient to him as meadows, forests and marshy grounds. He requires a soil which is easily pierced, and yet so tenacious as not to tumble down. He likewise chooses countries which abound in all kinds of grain, that he may not be obliged to seek his food at great distances, for which he is not well qualified. In Thuringia, the soil of which possesses all these qualities, the hamsters are more numerous than in any other country.

The habitation, which the hamster digs to the depth of three or four feet, consists of more or fewer apartments, according to the age of the animal. The principal chamber is lined with straw, and serves him for a lodging. The others are destined for the preservation of provisions, of which he amasses great quantities during the autumn. Each hole has two apertures; the one descends obliquely, and the other, through which the animal goes out and in, is perpendicular.

The holes of the females, who never live with the males, are somewhat different. In those where she brings forth, there is seldom above one chamber for provisions; because the short time the young remain with her requires not a great store of food. But, instead of one perpendicular hole, she makes seven or eight, to give free passage to her young. Sometimes the mother banishes her offspring, and continues to possess this hole; but she commonly digs another, and lays up as much provisions as the season permits her to collect.

The hamsters copulate about the end of April, when the males enter the apartments of the females, where they remain only a few days. If two males happen to meet in the same hole, a furious combat ensues, which generally terminates in the death of the weakest. The conqueror takes possession of the female, and both, though at every other period they persecute and kill each other, lay aside their natural ferocity during the few days their amours continue. They even mutually defend each other against aggressors. When a hole is opened at this period, and the female perceives that her husband is about to be carried off, she darts upon the ravisher, and makes him feel the fury of her vengeance, by inflicting deep and painful wounds.

The females bring forth twice or thrice every year. Their litter is never fewer than six, and oftener from sixteen to eighteen. The growth of these animals is very rapid. At the age of fifteen days, they already begin to dig the earth. Soon after, the mother banishes them from her habitation; so that, at the age of about three weeks, they are abandoned to their own management. The mother, in general, discovers little tenderness for her offspring. She who, in the season of love, defends her husband with courage, flies in the most dastardly manner when her family is threatened with danger. Her only solicitude is to provide for her own safety. With this view, when pursued, she digs deeper into the earth, which she performs with an amazing quickness. The young would willingly follow her; but she is deaf to their cries, and even shuts the hole which she had made.

The hamster feeds upon all kinds of herbs, roots, and grains, which the different seasons produce. He even eats the flesh of such animals as he can conquer. As he is not adapted for long journies, his magazine is first stocked with the provisions which are nearest his abode. This is the reason why some of his chambers are frequently filled with one kind of grain only. When the harvest is reaped, he goes to a greater distance in quest of provisions, and carries every article he can find, without distinction, to his granary. To facilitate the transportation of his food, Nature has furnished him with two pouches in the inside of each cheek. On the outside, these pouches are membranous, smooth, and shining; and, in the inside, there are a great many glands, which continually secrete a certain fluid, to preserve their flexibility, and to enable them to resist any accidents which may be occasioned by the roughness or sharpness of particular grains. Each of these cheeks is capable of containing an ounce and a half of grain, which, on his return to his habitation, he empties, by pressing his two fore feet against his cheeks. When we meet a hamster having his cheeks filled with provisions, it is easy to seize him with the hand, without the risk of being bitten; because, in this condition, he has not the free motion of his jaws. But, if he is allowed a little time, he soon empties his pouches, and stands upon his defence. The quantity of provisions found in the holes depends on the age and sex of the inhabitant. The old hamsters often amass a hundred pounds of grain; but the young and the females content themselves with a quantity much smaller. Their object in laying up provisions is not to nourish them during the winter, which they pass in sleep and without eating, but to support them after they awake in the spring, and previous to their falling into a torpid state.

At the approach of winter, the hamsters retire into their subterraneous abodes; the entry to which they shut up with great address. There they remain in perfect tranquillity, and feed on their provisions, till the frost becomes severe, when they sink into a torpid state, which resembles a profound sleep. When, during this period, the holes are opened, which we know by a small eminence of earth raised near the oblique passage formerly described, we find the hamster lying upon a bed of soft straw. His head is bended under his belly, between the two fore legs, and those behind rest upon his muzzle. The eyes are shut; and, when the eye-lids are forced open, they instantly close again. The members are stiff, like those of a dead animal, and the whole body feels as cold as ice. Neither respiration nor any other sign of life can be perceived. When dissected in this situation, we see the heart alternately contracting and dilating. But this movement is so slow, that the pulsations exceed not fifteen in a minute; though, when the animal is awake, the heart beats a hundred and fifty strokes during the same time. The fat has the appearance of being coagulated. The intestines are as cold as the external parts of the body, and discover not the smallest irritability upon the application of spirit of wine or oil of vitriol. During this operation the animal seems to feel very little. He sometimes opens his mouth, as if he wanted to respire. But his lethargy is too strong to admit of his wakening entirely.

The lethargy of the hamster has been ascribed solely to a certain degree of cold: this may be true with regard to the dormice and bats. But experience proves, that, in order to render the hamster torpid, he must also be excluded from all communication with the external air: for, when a hamster is shut up in a cage filled with earth and straw, and exposed in winter to a degree of cold sufficient to freeze water, he never becomes torpid. But, when the cage is sunk four or five feet under ground, and well secured against the access of air, at the end of eight or ten days he is equally torpid as if he had been in his own burrow. If the cage is brought up to the surface, the hamster will awake in a few hours, and resume his torpid state when put below the earth. This experiment may be repeated with the same success, as long as the frost continues. We have a farther proof that the absence of the air is one of the causes of torpidness in the hamster: when brought up from his hole, in the coldest weather, and exposed to the air, he infallibly awakes in a few hours. This experiment succeeds equally either in the night or day, which proves that the light forms no part of the cause.

It is curious to observe the hamster passing from a torpid to an active state. He first loses the rigidity of his members, and then makes a profound respiration, but at long intervals. His legs begin to move, he opens his mouth, and utters disagreeable and rattling sounds. After continuing these operations for some time, he opens his eyes, and endeavours to raise himself on his legs. But all these movements are still reeling and

unsteady, like those of a man intoxicated with liquor. He, however, reiterates his efforts, till he is enabled to stand on his legs. In this attitude he remains fixed, as if he meant to reconnoitre, and repose himself after his fatigues. But he gradually begins to walk, to eat, and to act in his usual manner. This passage, from a torpid to an active state, requires more or less time, according to the temperature of the air. When exposed to a cold air he sometimes requires more than two hours to awake, and in a more temperate air he accomplishes his purpose in less than one hour. It is probable that this change is produced imperceptibly when the animal is in his hole, and that he feels none of the inconveniencies which arise from a sudden and forced reviviscence.

The life of a hamster is divided between the necessary cares of satisfying his natural appetites, and the fury of combating. He seems to have no other passion but that of rage, which induces him to attack every animal that comes in his way, without attending to the superior strength of the enemy. Ignorant of the art of saving himself by flight, rather than yield he allows himself to be beat to pieces with a stick. If he seizes a man's hand, he must be killed before he quits his hold. The magnitude of the horse terrifies him as little as the address of the dog, which last is fond of hunting him. When the hamster perceives the dog at a distance he begins with emptying his cheek pouches if they happen to be filled with grain. He then blows them up so prodigiously, that the size of the head and neck greatly exceeds that of the rest of the body. In fine, he raises himself on his hind legs, and in this attitude darts upon the enemy. If he catches hold, he never quits it but with the loss of his life. But the dog generally seizes him behind, and strangles him. This ferocious temper prevents the hamster from being at peace with any other animal. He even makes war against his own species, not excepting the females. When two hamsters rencounter they never fail to attack each other, and the stronger always devours the weaker. A combat between a male and a female commonly lasts longer than between two males. They begin by pursuing and biting each other; then each of them retire to a side, as if to take breath; a little after they renew the combat, and continue to fly and to fight till one of them falls. The vanquished uniformly serves for a repast to the conqueror.

THE BOBAK, AND OTHER MARMOTS.

THE hamster has been called the *Strasburgh marmot*, and the bobak the *Polish* marmot. But it is equally certain that the hamster is not a marmot, as it is probable that the bobak does belong to that species; for the bobak differs from the Alpine marmot only in the colour of his hair, which instead of brown is a pale yellow. He has also a thumb, or rather a claw on the fore feet; while the marmot has only four toes and no thumb. In every other article the resemblance is perfect; from which it is to be presumed, that these two animals are not distinct species. The same observation applies to the *monax* or *marmot of Canada*, which by some travellers has been called the *whistler*. He seems to differ from the marmot only by the tail, which is longer and more bushy. Hence the monax of Canada, the bobak of Poland, and the Alpine marmot, appear to be the same animal, which, from the influence of different climates, have undergone the varieties formerly mentioned. As this species prefers the coldest and most mountainous regions, and as it is found in Poland, Russia, and other parts of the north of Europe, it is not surprising that it should likewise be found in Canada, where it is only smaller. Neither is this circumstance peculiar to the marmot; for all the animals common to both continents are smaller in the New than in the Old World.

[The Alpine and Polish marmots are a foot and a half long from the extremity of the muzzle to the origin of the tail; but the monax, or Canadian marmot, exceeds not fourteen or fifteen inches in length.]

The Siberian animal, which the Russians call *jevraschka*, is a species of marmot still smaller than the Canadian monax. It has a round head and a blunt nose. It has no external ears, and the auditory passages can only be discovered by removing the hair. The length of the body, including the head, exceeds not a foot; and the tail, which is round near the body, then flat, and truncated at the extremity, is but three inches long. The body of this animal is pretty thick, the hair is yellow mixed with gray, and that on the end of the tail is almost black. The legs are short, those before being somewhat longer than those behind. The hind feet have five toes and five black claws, which are a little crooked; and the fore feet have only four. When these animals are irritated, or attempted to be seized, they bite violently, and set up a sharp cry, like the marmot. When they eat they sit on their buttocks, and carry the victuals to their mouths with the fore paws. They come in

season in spring, and bring forth in summer. The litter is generally five or six. They dig holes in the earth, where they pass the winter, and where the female brings forth and suckles her young. Though they have a great resemblance to the marmot, yet they appear to be of a different species; for in the same parts of Siberia there are genuine Polish or Alpine marmots, which the natives call *surok;* and it has never been remarked that the two kinds mix or produce an intermediate race.

THE JERBOAS.

THE Egyptian jerboa, with thin, erect, and broad ears, full and dark eyes, and long whiskers. The fore legs are an inch long, with five toes on each, the inner or thumb being scarce apparent; but that as well as the rest furnished with a sharp claw. The hind legs are two inches and a quarter long, thinly covered with hair, and exactly resembling those of a bird; three toes on each foot, covered above and below with hair: the middle toe is the longest, and on each side is a pretty long sharp claw. The length from nose to tail is seven inches and one quarter; the tail ten inches, terminated with a thick black tuft of hair; the tip white. The rest of the tail is covered with very short coarse hair. The upper part of the body is thin, or compressed sidewise. The part about the rump and loins is large. The head, back, sides, and thighs, are covered with long hair, ash-coloured at the bottom, and pale tawny at the ends. The breast and belly are whitish, and the hair long and soft.

Jerboa is a generic name, employed to denote those animals which are remarkable for the disproportion between the hind and fore legs, the latter not exceeding the length of a mole's paws, and the former resembling the legs of a bird. In this genus we are acquainted with four species, or distinct varieties: 1. The tarsier, or woolly jerboa formerly mentioned, which is certainly a particular species, because it has five toes on each foot, like those of a monkey. 2. The jerboa, properly so called, which has four toes on the fore feet, and three on the hind. 3. The alagtaga, whose legs are constructed like those of the jerboa, but which has five toes on the fore feet and three on the hind, with a spur that may pass for a thumb or fourth toe, much shorter than the others. [Siberian jerboa, with very long transparent narrow ears, long whiskers, and five toes on the fore feet, three on the hind feet pointing forward, and a fourth behind, about an inch above the heel. The colour of the upper part of the body is tawny, and of the lower whitish. In form of body, legs, and tail, it agrees with the Egyptian jerboa.—*Pennant.*] 4. The *daman Israel*, or *lamb of Israel*, which may be the same animal called *mus longipes* by Linnæus, and which has four toes on the fore feet, and five on those behind.

The head of the jerboa has a great resemblance to that of the rabbit; but its eyes are larger, and its ears shorter, higher, and broader, in proportion to its size. The nose is flesh-coloured and naked; and the muzzle is thick and short. The opening of the mouth is very small; the upper jaw is very broad, and the under narrow and short. The teeth are like those of the rabbit; and the whiskers round the mouth are composed of long black and white hairs. The fore feet are extremely short, and never touch the ground, being used only as hands to convey victuals to the mouth. These hands have four fingers armed with claws, and the rudiments of a fifth without any claw. The hind feet have only three toes, of which the middle one is longest, and all three are armed with claws. The tail is three times longer than the body; it is covered with small stiff hairs of the same colour with those on the back, and the extremity of it is garnished with longer, softer, and more bushy hair. The legs are naked and flesh-coloured, as well as the nose and ears. The top of the head and back are covered with reddish hair, and the flanks, the under part of the head, the throat, the belly, and the inside of the thighs, are white: below the reins and near the tail there is a large, black, transverse band in the form of a crescent.

The alagtaga is smaller than a rabbit. His ears are long, broad, naked, thin, transparent, and spread over with very conspicuous blood-vessels. The upper jaw is much larger than the under, but blunt and pretty broad at the extremity. It has large whiskers round the mouth. The teeth are like those of a rat. The eyes are large; and the iris or pupils are brown. The body is narrow before, broad and almost round behind. The tail is very long, not so thick as a small finger, and two-thirds of it are covered with short stiff hair; on the last third the hairs are longer, more bushy, softer, and become longer toward the extremity, where they form a kind of tuft, which is black at the beginning, and white at the end. The fore feet are very short, and have five toes; those behind are very long, and have only four toes, three of which are placed before, and the fourth, which is a thumb, stands at a distance from the others.

All these toes are armed with claws which are shorter in the fore than in the hind feet. The hair of this animal is soft, pretty long, yellow on the back, and white on the belly.

From comparing these two descriptions, the first of which is taken from Edwards and Hasselquist, and the second from Gmelin, it appears that the jerboa, and alagtaga resemble each other in a striking manner. The jerboa is only smaller than the alagtaga, and has but four toes on the fore feet, and three on the hind, without any spur; while the alagtaga has five toes on the fore feet, and three and a spur on the hind feet. But I suspect that this difference is not constant; for Dr. Shaw, who has given a figure and description of a Barbary jerboa, represents it with a spur or fourth toe on the hind feet; and Mr. Edwards remarks, that he carefully examined two jerboas which he saw in England, and could discover no spur. Hence this character, which might serve as a specific distinction between the jerboa and alagtaga, by not being constant, answers no purpose, but marks rather the identity than the diversity of the species. Neither does the difference in size prove them to be distinct species: Edwards and Hasselquist may have described only young jerboas, and Gmelin an old alagtaga.

Two circumstances, however, render this matter still doubtful; the proportion of the tail, which is much larger in the jerboa than in the alagtaga, and the difference of the climates which they inhabit. The jerboa is common in Circassia, Egypt, Barbary, and Arabia; and the alagtaga in Tartary, along the Wolga, and as far as Siberia. It is seldom that the same animal inhabits climates so different; and, when it does happen, the species undergoes great changes: this we presume to be the case with the jerboa, of which, notwithstanding these differences, the alagtaga seems to be only a variety.

[In Circassia, Persia, Arabia, and the environs of Babylon, there is a kind of field-mouse, called *jerbuach* in the Arabic language, which is nearly of the size and colour of the squirrel.—When it leaps, it darts five or six feet above the ground.—It sometimes quits the fields, and takes up its abode in the houses.—*Olearius.*

'In Egypt, I saw two small animals, that ran very quickly on their hind feet, which were so long that the creatures seemed to be mounted on stilts. These animals burrow like rabbits. I carried off seven of them; two of which I brought to France, where they lived in the royal menagery two years.'—*Paul Lucas.*]

These animals generally conceal their hands or fore feet among the hair; so that, at first sight, they seem to have only two feet. In transporting themselves from place to place, they do not walk, or advance one foot after another, but leap nimbly to the distance of three or four feet. When reposing themselves, they sit on their knees, and sleep only during the day. They eat grain and herbage, like the hare. Their dispositions are mild, and yet they can never be tamed beyond a certain point. They dig holes in the earth like the rabbits, and in a much shorter time. About the end of summer, they lay up herbage in their magazines, where, in cold countries, they pass the winter.

With regard to the daman, or lamb of the children of Israel, which seems to be a kind of Jerboa, because its fore legs are remarkably shorter than the hind, having never seen this animal, we cannot do better than copy the remarks of Dr. Shaw, who had an opportunity of comparing it with the jerboa, and speaks of them as two distinct species. 'The daman,' says this author, 'is likewise an animal of Mount Libanus, though common in other places of this country. It is a harmless creature, of the same size and quality with the rabbit; and with the like incurvating posture and disposition of the fore teeth. But it is of a browner colour, with smaller eyes, and a head more pointed, like the marmots. The fore feet likewise are short, and the hinder are nearly as long in proportion as those of the jerboa. Though this animal is known to burrow sometimes in the ground; yet, as its usual residence and refuge is in the holes and clifts of the rocks, we have so far a more presumptive proof, that this creature may rather be the saphan of the Scriptures, than the jerboa. I could not learn why it was called daman Israel, *i. e.* Israel's lamb, as these words are interpreted.' Prosper Alpinus, who mentioned this animal before Dr. Shaw, says, that its flesh makes excellent eating, and that it is larger than the European rabbit. But this last fact seems to be suspicious; for Dr. Shaw has omitted this passage of Prosper Alpinus, though he transcribes all the other remarks of that author.

THE ICHNEUMON.

ICHNEUMON weasel, with bright flame-coloured eyes, small rounded ears, almost naked, nose long and slender, and the body thicker than that of others of this genus. The tail is very thick at the base, tapering to a point. The legs are short; and the hair is hard and coarse. The colour varies in different animals from different countries; in some it is alternately barred with dull yellowish, brown, and white; in others, pale brown

and mouse-coloured; so that the animal appears mottled. The throat and belly are of a uniform brown. Beneath the tail is an orifice, not unlike that of a badger. It differs in size, from twenty-four to forty-two inches in length, from the tip of the nose to the end of the tail.

In Egypt, the ichneumon is domestic like the cat in Europe, and preys upon mice and rats. But his appetite for flesh is still more violent, and his instinct more extensive, than those of the cat; for he hunts and eats, with equal avidity, birds, quadrupeds, serpents, lizards, insects, and, in general, every animated being. His courage is equal to the vehemence of his appetite. He dreads neither the rage of the dog nor the malice of the cat. He is not afraid even of the bite of serpents, which he pursues and kills; and, when he begins to feel the effects of their poison, he goes in quest of an antidote, and particularly of a root, which the Indians call by his name, and alledge that it is one of the most powerful and certain remedies against the bite of the viper or asp. He eats the eggs of the crocodile, as well as those of hens and other birds. He likewise kills and eats the young crocodiles, though they are very strong soon after they issue from the egg; and, as fable is always a concomitant of truth, it has been alledged, that, in consequence of this antipathy to the crocodile, the ichneumon enters into the crocodile's body while asleep, and never leaves him till his bowels are entirely devoured.

[The ichneumon, or rat of Pharaoh, is a small kind of wild hog. It is a beautiful animal, easily tamed, and its hair is bristly, like that of the porcupine. It is an enemy to all other rats, and has a particular antipathy to the crocodile, whose eggs it devours, and boldly attacks the young, by seizing them by the tail, instead of the head.—*Maillet.*]

Naturalists have imagined that there are different species of ichneumons, because they vary in size and colour. But, if we consider that they are often reared in houses, and must, like other domestic animals, undergo changes, we will be easily persuaded, that the diversities in colour and size are only simple varieties, and are not sufficient to constitute distinct species; especially as, in two ichneumons which I saw alive, and in several stuffed skins, I examined the intermediate shades both of colour and size, and remarked, that not one of them differed from the others by any evident and constant character. It only appears, that in Egypt, where the ichneumons are in a manner domestic, they are larger than in India, where they are wild.

[This ichneumon, says Edwards, came from the East Indies, and was very small. I saw another which came from Egypt, and was more than double the size.—Beside the size, the only other difference between these two ichneumons was, that the Egyptian kind had a small tuft at the extremity of the tail, while that of the Indian kind terminated in a point. I believe they are two distinct species; because that of India, which was comparatively so small, had acquired its full growth.—*Edwards. Nota.* These differences are not sufficient to constitute two species, especially as between the largest and smallest, that is, from thirteen to twenty-two inches in length, there are intermediate sizes of fifteen and sixteen inches. Seba, who has given a figure and description of one of these small ichneumons, which he had alive, and was brought from Ceylon, remarks, that it was very mischievous, and could not be tamed. This difference of disposition might indicate a difference of species. But it has so perfect a resemblance to those we have already mentioned, that it is unquestionably the same animal. Besides, I saw one of these small ichneumons, which was so tame, that its master (M. le President de Robien) carried it always in his hat, and exhibited to the whole world the mildness and good nature of this animal.]

The nomenclators, who perpetually blunder with regard to species, have differed widely as to the ichneumon. Linnæus first made it a badger, and afterwards a ferret. Hasselquist, following the lessons of his master, likewise made it a badger. Klein and Brisson have placed it among the weasels. Others have made it an otter, and others a rat. I mention these notions for the sole purpose of showing the inconsistencies and contradictions that arise from what are called *generic names*, which are generally false, arbitrary, and equivocal.

The ichneumon loves the banks of rivers. During inundations, he retires to the high grounds, and often approaches the habitations of men in quest of prey. In walking, he makes no noise, and varies his gait according to circumstances. Sometimes he carries his head high, contracts his body, and raises himself on his limbs. At other times, he has the air of creeping and of lengthening his body like a serpent. He often sits on his hind legs; and still more frequently darts like an arrow on his prey. His eyes are vivacious and full of fire. His aspect is beautiful, his body very agile, his limbs short, his tail thick and very long, and his hair rude, and often curled. Both male and female, independent of the natural passages, have a remarkable aperture, a kind of pouch in which an odoriferous liquor is secreted. The ichneumon is said to open this pouch in order to refresh himself when too warm. His sharp muzzle and narrow mouth prevent him from seizing large objects. But the defects of his weapons and strength, he supplies by agility and courage. He easily worries a cat, though larger and stronger than himself. He often combats with dogs, and, however large, forces respect from them.

[The inhabitants of Alexandria rear an animal called *ichneumon*, which is a native of Egypt. They tame and keep it in their houses, like a cat or dog. The vulgar call it the *rat of Pharoah*. The peasants bring these

animals when young to Alexandria, where they are kept in the houses, on account of their hunting rats, serpents, &c. This animal is very cunning in watching its prey. He feeds indifferently on all living creatures, as beetles, lizards, cameleons, all kinds of serpents, frogs, rats, and mice. He is fond of birds and poultry. When provoked he erects his hair. He has a peculiar mark, a large aperture surrounded with hair near the anus, resembling the female organ, which he opens when too warm.—*Belon.*]

This animal grows quickly, and lives but a short time. They are numerous in all the southern regions of Asia, from Egypt to Java; and they appear to exist in Africa, as far as the Cape of Good Hope. But they cannot be easily reared or preserved in our temperate climates. Whatever care be taken of them, the wind incommodes, and the frost kills them. To avoid both, and preserve their heat, they roll themselves up, and conceal their head between their thighs.

[The ichneumon is a small beautiful animal, shaped nearly like our French weasels, but of a colour incomparably finer. The white and black predominate; and there is a kind of red, which constitutes the shade between the two. The hair of the tail is of the same colour, but longer than that of the body. The head is covered with short smooth hair.* Its eyes are large, and its ears short and rounded. This ichneumon was two feet and a half long from the nose to the extremity of the tail. It was brought from the kingdom of Calicut to France in a vessel belonging to our squadron. It lived five months in Paris, and became very familar.—*Curiosit. de la Nature et de l'Art.*]

The ichneumon has a small soft voice, a kind of murmur, and its cry never becomes sharp unless when struck or irritated. This animal was held in great veneration among the ancient Egyptians, and still merits protection on account of the number of noxious animals which he destroys, and particularly the crocodiles, whose eggs it knows how to find though concealed in the sand. The crocodiles lay such a number of eggs that their multiplication would be extremely formidable if the ichneumon did not destroy them.

THE FOSSANE.

FOSSANE weasel, with a slender body, rounded ears, and black eyes. The body and legs are covered with cinereous hair, mixed with tawny. The sides of the face are black. From the hind part of the head, towards the back and shoulders, four black lines extend. The shoulders, sides, and thighs, are black, and the tail is annulated with black. *Fossa* or *fossane* is the name of this animal at Madagascar, which we have adopted.

By some travellers the fossane is called the *genet of Madagascar*, because it resembles the genet in colour, and some other articles. But it is constantly smaller, and has not the odoriferous pouch, which is an essential character of the genet. As we were uncertain as to this fact, we wrote to M. Poivre, who had sent us a stuffed skin, and who obliged us with the following answers, dated Lyons, July 19, 1761: 'The fossane which I 'brought from Madagascar had the manners of our mar- 'tin. The inhabitants of the island assured me that the 'genitals of the male, when in season, had a strong 'odour of musk. When the skin was stuffed at the 'royal garden, I examined it attentively, and could per- 'ceive no pouch or smell of musk. I reared a similar 'animal in Cochinchina, and another in the Philippine 'islands. Both of them were males, and they became 'a little familiar. They were very young, and I kept 'them only two or three months. I found no pouch in 'the part you mentioned; and I only perceived that 'their excrements had an odour similar to those of our 'martin. They eat flesh and fruits; but they preferred 'the latter, and showed a decided taste for bananas, 'upon which they sprung with great avidity. This ani- 'mal is very wild and difficult to tame. Though taken 'when young his air and character were always ferocious, 'which seemed to be uncommon in an animal that feeds 'spontaneously on fruits. The eye of the fossane is 'a large black globe, which gives it a mischievous 'aspect.'

We rejoice in this opportunity of expressing our gratitude to M. Poivre, who, from his attachment to natural history, and his friendship to those who cultivate that science, has adorned the royal cabinet with a great number of rare and valuable articles.

It appears to us, that the animal called *berbe* in Guinea is the same with the fossane, and, consequently, that this species exists in Africa as well as in Asia. 'The berbé has a sharper muzzle and a smaller body 'than the cat; and is spotted like the civet.' We have no animal to which these characters apply so well as to the fossane.

THE VANSIRE.

THE Madagascar weasel with short ears. The hair on the whole body and tail is brown at the roots, and barred above with black and ferruginous. The length from nose to tail is about fourteen inches; and that of the tail to the tip of the hairs at the end, near ten.

Those who mention this animal have taken it for a ferret, to which it has a great resemblance. But it differs from the ferret by such characters as justify us in considering it as a distinct species. The vansire has twelve grinding teeth in the upper jaw, and the ferret only eight; and though each of these animals has ten grinders in the under jaw, they neither resemble one another in figure nor situation. Besides, the colour of the vansire differs from that of all other ferrets; though these last, like all domestic animals, vary so much from each other in colour, that even the male differs from the female.

To us it appears, that the animal mentioned by Seba, under the denomination of the *Java weasel*, called by the natives *koger-angan*, and afterwards, by Brisson, the *ferret of Java*, may be the same animal with the vansire; at least it makes a nearer approach to the vansire than any other animal. But Seba's description is not sufficiently complete to enable us to form an explicit judgment.

SUPPLEMENT.

The vansire, as formerly remarked, is a native of Madagascar and the interior parts of Africa. It has a great resemblance to the ferret, except in the number and form of the teeth, and in the tail, which is much longer in the vansire than in our ferret. The Arabian ferrets, or *nems*, have a greater resemblance to the vansire than to our European ferrets. M. de Seve gives the following description of the *nems*:

'The *nems*, from his figure and flexibility, is a genuine ferret. When he walks he lengthens his body, and appears to have very short legs. The individual under consideration was a male, and about thirteen inches and a half long from the muzzle to the anus, and the length of the tail was one foot. The fore part of the body is five inches and a half high, and the hind part six inches and a half. The ears are naked, and of the same figure with those of the common ferret. The eye is vivacious, and the colour of the iris a deep yellow. The muzzle, which is very sharp, appeared not to have any whiskers. The whole body is covered with long hair, which is a mixture of dark brown and a dirty white, and gives it a resemblance to the silvery rabbit. The hair on the belly is of a bright yellow colour, without any mixture. The ground colour on the head and round the eyes is clear and yellowish: on the nose, cheeks, and other parts of the face where the hair is short, a tincture of brown, more or less deep, prevails without mixture, and gradually loses itself above the eyes. The legs are covered with short hair, of a deep yellow colour. On the paws there are four toes, and a small one behind. The claws are small and black. The tail, which is more than double the length of that of our ferrets, is very thick at its origin, terminates in a point, and is covered with hair similar to that on the body. This animal, according to the information of the boy who has the charge of it never drinks.'

THE MAKIS, OR MAUCAUCOS.

RING-TAILED maucauco with the end of the nose black, erect ears, white face, and black circles round the orbits. The hair on the top and hind part of the head is of a deep ash-colour; the back and sides are of a reddish ash-colour; the outsides of the limbs are paler; and the belly and insides of the limbs are white. All its hair is very soft, close, fine, and erect, like velvet. The tail is twice the length of the body, and marked with numbers of regular rings of black and white; and when sitting it is twisted round the body, and brought over its head. The nails are flat, particularly those of the thumbs of the hind feet. The inside of the hands and feet are black. It is of the size of a cat.

As the name *maki* has been given to several animals, we could only employ it as a generic term, under which we shall comprehend three animals of the same genus, but of distinct species. These three animals have long tails, and feet like those of the monkey; but their muzzle is long, like that of the martin, and they have six cutting teeth in the under jaw, while the monkeys

have only four. The first of these animals is the mococo or maucauco, commonly known by the name of the ring-tailed *maki*. The second is the mongous, commonly called the *brown maki*. But this denomination is improper; for some individuals are all brown, and others have their cheeks black, and their feet yellow.

[The woolly maucauco, with orange-coloured irides, short rounded ears, end of the nose black, eyes loged in a circle of black, and the space between them of the same colour. The rest of the nose and lower sides of the cheeks are white. When in full health, the whole upper part of the body is covered with long, soft, and thick fur, a little curled or waved, and of a deep brownish ash-colour. The tail is very long, and covered with the same sort of hair, and of the same colour. The breast and belly are white, and the hands and feet naked and dusky. The nails are flat, except that of the inner toe of the hind feet. It is of the size of a cat. The paws are sometimes white or yellow, and the face wholly brown.—*Pennant.*]

The third is the *vari*, by some called the *pied maki*. But this denomination is ill applied; for, besides the pied variety, some individuals are entirely black, and others entirely white.

[The ruffed maucauco, with orange-coloured irides, long hair round the sides of the head, standing out like a ruff, and a long tail. The colour of the whole animal is black, but not always, being sometimes white, spotted with black; but the feet are black. It is rather larger than the ring-tailed species.—*Pennant.*]

These animals are all natives of the eastern regions of Africa, and particularly of Madagascar, where they are very numerous.

The maucauco is a beautiful animal. His aspect is agreeable, his figure elegant, and his hair always neat and glossy. He is remarkable for the largeness of his eyes, the height of his hind legs, which are much longer than those before, and his large and handsome tail, which is always erect, always in motion, and garnished with thirty alternate rings of black and white, well marked and separated from each other. His manners are gentle, and, though he has a great resemblance to the monkeys, he possesses none of their malicious dispositions. In a state of liberty, the maucaucos live in society, and they are found in Madagascar in troops of thirty or forty. In a domestic state, the prodigious rapidity of their movements renders them incommodious. It is for this reason alone that they are generally chained; for, though extremely active and vivacious, they are neither mischievous nor ferocious. They tame to such a degree as to go out and return, without any danger of running off. Their gait is oblique, like that of all animals which have hands instead of feet. The maucauco leaps more gracefully than he walks. He is a silent animal, uttering only a short acute cry when surprised or irritated. He sleeps in a sitting posture, with his muzzle resting on his breast. His body is not thicker than that of a cat, but it is longer; and the height of his legs gives him the appearance of being larger than he really is. His hair, though very soft to the touch, stands always erect. In the male maucauco, the organs of generation are small and concealed; but those of the mongous, or woolly maucauco, are disproportionally large, and very apparent.

The mongous is smaller than the macauco; his hair is likewise silky, pretty short, and somewhat curled. His nose is larger than that of the maucauco, and resembles that of the vari. I had a mongous in my possession for several years, which was altogether brown. It had yellow eyes, a black nose, and short ears. It amused itself with eating its own tail, and actually destroyed the last four or five vertebræ. This animal was extremely dirty, and so troublesome that we were obliged to chain him. Whenever he could make his escape, he went into the neighbouring shops in quest of fruits, sugar, and sweetmeats, and opened the boxes which contained them. It was difficult to seize him, and he bit cruelly even those with whom he was best acquainted. He uttered a low grunting noise, almost perpetually; and, when tired of being alone, he croaked like a frog, and so loud as to be heard at a great distance. This mongous was a male, and his testicles were extremely large in proportion to the size of his body. He was fond of the she-cats, and even satisfied his desires, without any intimate union: his embraces were, of course, ineffectual. He dreaded cold and moisture; he never departed from the fire, and stood on end to warm himself. He was fed with bread and fruits. His tongue was rough, like that of a cat; and, when permitted, he licked a person's hand till it was inflamed, and often finished this operation with a severe bite. The cold of the winter 1750 killed him, though he never quitted his station near the fire. His movements were extremely brisk, and sometimes petulant. He often slept during the day; but his slumbers were so light, that the smallest noise awaked him.

In this species there are several varieties, both in colour and size: the mongous, whose history has just now been given, was totally brown, and about the size of an ordinary cat. I saw one, which, though an adult, was not larger than the fat squirrel. If this small mongous had not perfectly resembled the large kind, except in size, it would unquestionably have been a distinct species. But, as we have no evidence that these two animals do not intermix, we must still regard them as the same species, till we acquire some new light as to their history and œconomy.

The vari is larger, stronger, and more ferocious than the maucauco. In a state of liberty, he is even dangerous. We are told by travellers, 'That these ani-

'mals are as furious as tigers; that they make such a 'noise in the woods, that, when only two of them are 'together, one would believe there were a hundred; 'and that it is difficult to tame them.' The voice of the vari has some resemblance to the roaring of a lion, and is tremendous to those who hear it for the first time. This astonishing strength of voice, in a middle-sized animal, depends on the singular structure of its wind-pipe, the two branches of which widen, and form a large cavity, before they enter the lungs. Hence he differs from the maucauco both in structure and dispositions. His hair, in general, is longer; and he has a kind of a ruff or cravat of still longer hair, which surrounds his neck, and forms a very distinct character by which he is easily known. In colour he varies from white to black, or pied; and his hair, though long and very soft, stands almost perpendicular to the skin. His muzzle is larger and proportionally longer than that of the maucauco. His ears are much shorter, and fringed with long hairs. His eyes are of so deep an orange colour, that they appear to be red.

The maucauco, the mongous, and the vari, belong to the same country, and seem to be confined to Madagascar, Mosambique, and the lands adjacent to these islands. They appear to be in the Old Continent what the opossums are in the New, which last, like the former, have four hands. With regard to figure, the makis seem to constitute the shade between the long-tailed monkeys, and the digitated quadrupeds. Like the monkeys, they have four hands and a long tail; and, at the same time, their muzzle is long like that of the fox or pole-cat. In manners, however, they have a greater resemblance to the monkeys, for though they sometimes eat flesh, and likewise lie in wait for birds, they are more frugiverous than carnivorous, and prefer, even in a domestic state, fruits, roots, and bread, to flesh, either raw or roasted.

[In the province of Melagasse in Madagascar, the different species of monkeys are extremely numerous. Some of them are brown, with woolly hair, and a long bushy tail, which they raise above their backs, and form a shade with it to protect themselves from the sun and rain. In this manner they sleep, like the squirrels, upon the branches of trees. Besides, they have round ears, and a muzzle like the martin. This species is not so troublesome and malicious as the other kinds. The antavarres have the same kind of hair with the former, and a white ruff round the neck. Some of them are entirely white, with a long muzzle. They are as large as the former, and grunt like hogs.—*F. Cauche. Note* —This passage plainly points out the mongous and vari; and it is upon this authority that I have said, that some vari's are black, others pied, and others entirely white.]

THE LORIS, OR TAILLESS MAUCAUCO.

MAUCAUCO with a small head, sharp pointed nose, orbits surrounded with a black circle, and a white space between them. From the top of the head, along the middle of the back, to the rump, there is a dark ferruginous line, which on the forehead is bifurcated. The ears are small. The body is covered with short, soft, and silky ash-coloured, and reddish fur. The toes are naked, and the nails flat; those of the inner toe on each hind foot are long, crooked, and sharp. The length of the animal, from the nose to the rump, is sixteen inches.

The Loris is a small animal of Ceylon, which is very remarkable for the elegance of its figure, and the singularity of its conformation. Of all animals, its body is, perhaps, the longest in proportion to its bulk. It has nine lumbar vertebræ, whilst all other quadrupeds have only five, six, or seven. The length of its body is an effect of this structure; and it appears still longer, because it wants a tail. Were it not for this defect of tail, and the uncommon number of the vertebræ, it might be comprehended under the list of makis; for it resembles them in the hands and feet, in the quality of the hair, in the number of teeth, and in the pointed muzzle. But, independent of the singularity above taken notice of, which removes this animal from the makis, he has other peculiar qualities. His head is entirely round, and his muzzle is almost perpendicular to this sphere. His eyes are exceedingly large, and very near each other. His ears are large, rounded, and garnished in the inside with three auricles, in the form of a small shell. But, what is still more remarkable, and perhaps peculiar to this animal, the female discharges her urine by the clitoris, which is perforated like the penis of the male; and these two organs have a perfect resemblance to each other, both in figure and size.

Linnæus has given a short, but excellent description of this animal. It is likewise very well represented by Seba; and it appears to be the same animal of which Thevenot speaks in the following terms: 'I saw in the 'Mogul country apes which had been brought from 'Ceylon. They were much esteemed, because they ex-

'ceeded not the size of a man's hand, and were of an 'uncommon species. Their front was flat, their eyes 'large and round, and of a bright yellow colour, like 'those of certain cats. Their muzzle is very sharp, and 'the inside of their ears is yellow. They have no tail. 'When I examined them, they stood on their hind feet, 'often embraced each other, and looked stedfastly on 'the people without being afraid.'

THE SERVAL, OR MOUNTAIN CAT.

THIS animal, which lived several years in the royal menagerie, appears to be the same with that described by the gentlemen of the academy under the name of *chat-pard;* and we should perhaps have been still ignorant of its real name if the Marquis de Montmirail had not discovered it in an Italian book, of which he sent us the following passage in our own language: 'The *maraputa,*' says P. Vincent-Marie, 'which the Portuguese 'in India call *serval,* is a ferocious animal larger than a 'wild cat, and somewhat less than the civet; from which 'last he differs by having a rounder and larger head, and 'a kind of depression on the middle of the front. He 'resembles the panther in the colour of his hair, which 'is yellow on the head, back, and flanks, and white on 'the belly; and likewise in the spots, which are dis-'tinct, equally distributed, and a little smaller than 'those of the panther. His eyes are extremely brilliant. 'His whiskers are long and stiff; his tail is short; and 'his feet are armed with long hooked claws. He inha-'bits the mountains of India. He is seldom seen on the 'ground, but remains always on the trees, where he 'makes his nest, and seizes birds, which constitute his 'chief nourishment. He leaps from tree to tree as 'nimbly as a monkey, and with such address and agility that he runs through a considerable space in an instant, and may be said only to appear and disappear. 'He is extremely fierce, and yet he flies the aspect of 'man, unless when provoked, and particularly when his 'dwelling is injured: ne then becomes furious, darts 'upon the offender, and bites and tears nearly in the 'same manner as the panther.'

Neither captivity, nor good or bad treatment, can soften the ferocity of this animal. The one we saw at the menagerie was always prepared to dart upon those who approached him; and we were obliged to draw and describe him through the grate of his apartment. He was fed with flesh, like the panthers and leopards.

This serval or maraputa of Malabar and India appeared to be the same animal with the tiger-cat of Senegal and the Cape of Good Hope, which, according to the testimony of travellers, resembles the cat in its figure, and the tiger, (that is, the panther or leopard) by the black and white spots of its hair. 'This serval,' they remark, 'is four times larger than a cat. He is very voracious, 'and eats apes, rats, and other animals.'

From comparing the serval with the *chat-pard,* or mountain cat described by the gentlemen of the academy, we discovered no other differences than the long spots on the back, and the annulated tail of the former, which were wanting in the latter. The spots on the back of the serval are only placed nearer each other than on the rest of the body. But these differences are too slight to create any suspicion concerning the identity of the species of these two animals.

THE OCELOT, OR MEXICAN CAT.

THE Mexican cat has its head, back, upper part of the rump, and tail of a bright tawny colour. A black stripe extends along the top of the back from head to tail. From the nostrils to the corners of the eye is a stripe of black, and the forehead is spotted with black. The sides are whitish, marked lengthwise with long stripes of black, hollow and tawny in the middle; in which are sprinkled some small black spots; from the neck towards the shoulders point are others of the same colours, and the rump is marked in the same manner. The legs are whitish, varied with small black spots. The tail is spotted with small black spots near its base, and with larger near the end, which is black.

The ocelot is an American animal. It is ferocious and carnivorous, and may be ranked with the jaguar and couguar; for it approaches them in magnitude, and resembles them in figure and dispositions. A male and female were brought alive to Paris by M. l'Escot, and

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we saw them at the fair of St. Ovide in the month of September, 1764. They came from the neighbourhood of Carthagena, and had been carried off from their mother when very young, in the month of October, 1763. At the age of three months they had become so strong and cruel, that they killed and eat a bitch which had been given to them for a nurse. At the age of one year, when we saw them, they were about two feet in length; and it is probable that they had not then acquired above one half or two thirds of their full growth. They were exhibited under the name of the *tiger-cat;* but we have rejected this precarious and compound appellation, because the jaguar, the serval, and the margay or Cayenne cat, were transmitted to us under the same denomination, though each of these animals differ from one another as well as from the ocelot.

Fabri is the first author who mentions this animal in a distinct manner. He caused the drawings of Recchi to be engraved, and from these drawings, which were coloured, he composed a description of the ocelot. He likewise gives a kind of history of it from the writings and information of Gregoire de Bolivar. I have made these remarks with a view to remove a difficulty which had deceived all the naturalists as well as myself. This difficulty is to ascertain whether the two animals drawn by Recchi, the first under the name of *tlatlauhqui-ocelotl*, and the second under that of *tlacoozlotl*, *tlalocelotl*, and afterwards described by Fabri, as distinct species, are not the same animal. Though the figures are pretty similar, they were regarded as distinct animals, because their names, and even the descriptions of them, were different. I at that time imagined that the first might be the same with the jaguar, and therefore gave it the Mexican name *tlatlauhqui-ocelotl*, which I now perceive did not belong to it: and since I had an opportunity of seeing both the male and female, I am persuaded that the two described by Fabri are only the same animal, of which the first is the male and the second the female. Nothing less than an examination of the male and female together could have enabled us to detect this error. Of all spotted animals the robe of the male ocelot is unquestionably the most beautiful and most elegantly variegated. Even that of the leopard is not to be compared with it for vivacity of colours and symmetry of design, far less those of the jaguar, panther, and ounce. But in the female ocelot the colours are fainter, and the design more irregular. This remarkable difference deceived Recchi, Fabri, and others.

When the ocelot has acquired his full growth, he is, according to Bolivar, two feet and a half high, and about four feet in length. The tail, though pretty long, touches not the ground, and of course exceeds not two feet. He is a very voracious, and at the same time a timid animal. He seldom attacks men, and is afraid of dogs. When pursued he flies to the woods, and climbs a tree, where he remains in order to sleep, and to watch the passage of cattle or smaller animals, and darts down upon them whenever they are within his reach. He prefers blood to flesh; hence he destroys a great number of animals; because, instead of satiating himself by devouring their flesh, he only quenches his thirst by drinking their blood.

[Dampier mentions this animal under the name of the *tiger-cat*, 'The tiger cat of the Bay of Campeachy is 'about the size of a bull-dog. His legs are short, and 'his body resembles that of a mastiff. But in the head, 'hair, and the manner of hunting his prey, he has a 'great similarity to the tiger (*jaguar*), except that he is 'not so large. They are here very numerous. They de-'vour calves and game of all kinds, which abound in 'this country, and which render them less dangerous to 'men. Their aspect is extremely proud and ferocious.'—*Dampier.*]

In a state of captivity he retains his original manners. Nothing can soften the natural ferocity of his disposition, or calm the restlessness of his movements. For this reason he is always kept in a cage. 'At the age of 'three months,' says M. l'Escot, 'when these two 'young ocelots had devoured their nurse, I kept them 'in a cage, and fed them with fresh meat, of which they 'eat from seven to eight pounds a-day. The male and 'female rub against each other like our domestic cats. 'The males have a remarkable superiority over the fe-'males. Notwithstanding the violent appetite of these 'two animals for flesh, the female never presumed to 'partake till the male was satiated, or gave her the 'pieces he had rejected. I sometimes gave them a live 'cat, whose blood they sucked till the animal died; but 'they never eat its flesh. I put on board two kids for 'their subsistence; for they neither eat boiled nor salted 'meat.—*Letter of M. de l'Escot.*

It appears from the testimony of Bolivar, and likewise from that of M. l'Escot, that the female ocelot produces but two young at a litter; for the latter informs us, that before the two young ones mentioned above were taken, the mother was killed. The ocelots, like the jaguar, the panther, the leopard, the tiger, the lion, and all animals remarkable for the largeness of their size, produce but a small number at a time. But the productions of a cat, who may be associated with this tribe, are numerous; which is a proof, that the number produced depends more upon magnitude than figure.

THE MARGAY, OR CAYENNE CAT.

CAYENNE cat, with the upper part of the head, neck, back, sides, shoulders, and thighs of a bright tawny colour. The face is striped, downwards, with black. The shoulders and body are marked with stripes, and oblong, large, black spots, and the legs with small spots. The breast and inside of the legs and thighs, are whitish, and spotted with black. The tail is very long, and marked with black, tawny, and gray. It is of the size of a common cat.

The margay is much smaller than the ocelot. In size and figure, he resembles the wild cat, only his head is more square, his muzzle and tail longer, and his ears more rounded. His hair is also shorter than that of the wild cat, and he is marked with black bands and spots upon a yellow ground-colour. He was sent to us from Cayenne, under the name of the *tiger-cat*. He, indeed, is of the same nature with the cat, jaguar, and ocelot, animals who have received the appellation of *tigers* in the New Continent. According to Fernandez, this animal, when full grown, is not so large as the civet; and, according to Marcgrave, whose comparison seems to be more just, he is of the size of a wild cat, which he resembles likewise in natural dispositions, living on small animals, poultry, &c. But it is extremely difficult to tame him, and he never loses his natural ferocity. His colours vary, though they are generally such as we have represented them. This animal is very common in Guiana, Brasil, and all the other regions of South America; and he seems to be the same with the pichou of Louisiana. But the species is not so frequent in temperate as in warm climates.

If we take a survey of these cruel animals, whose skins are so beautiful, and whose nature is so perfidious, we shall find, in the Old Continent, the tiger, panther, leopard, ounce, and serval; and, in the New Continent, the jaguar, ocelot, and margay, which three appear to be miniatures of the former, and possessing neither the same stature nor strength; they are also timid and dastardly, in proportion as the others are bold and intrepid.

There is still another animal of this genus, which the furriers call *guepard*. We have seen several skins of it, which resembled those of the lynx in the length of the hair. But, as the ears are not terminated by pencils, the guepard is not a lynx. Neither is he a panther nor a leopard; for his hair is not short, and he has a mane of four or five inches long on his neck and between his shoulders. The hair on his belly is likewise three or four inches in length, and his tail is proportionally shorter than that of the panther, leopard, or ounce. He is nearly of the size of this last animal, being only about three feet and a half long. His fur, which is of a very pale yellow colour, is speckled, like that of the leopard, with black spots; but they are smaller and nearer each other, being only three or four lines in diameter.

I imagined that this animal was the same with that mentioned by Kolbe under the name of the *tiger-wolf*, whose description I have given.

[He is of the size of a common dog, and sometimes larger. His head is as big as that of a bull dog. His chops, as well as his muzzle and eyes, are large, and his teeth are very sharp. His hair is curled, like that of a water-dog, and spotted like that of a tiger. His paws are large, and armed with great claws, which he retracts at pleasure, like the cats. His tail is short. The lion, tiger, and leopard are his mortal enemies. They pursue him even to his den, dart upon him, and tear him in pieces.—*Kolbe. Nota.* The animal which this author calls the *tiger*, is the leopard, and what he calls the *leopard*, is the panther.]

He is common in the neighbourhood of the Cape of Good Hope. During the day he remains in the clefts of rocks, or in holes which he digs in the earth; and, in the night, he goes in quest of prey. But, when he hunts, he makes a howling noise, which alarms both men and animals; so that it is easy either to avoid or to kill him. In fine, the word *guepard* seems to be derived from *lepard*, the mode in which the Germans and Dutch spell *leopard*. We have also remarked, in this species, varieties both in the ground-colour and in that of the spots. But all the guepards have the common characters of long hair on the belly, and a mane on the neck.

SUPPLEMENT.

To the article *margay* we must refer the tiger-cat of Cayenne, mentioned by M. de la Borde in the following terms:

'The skin of the tiger-cat, like that of the ounce, is 'very much spotted. Though he has the dispositions 'of the fox, he is somewhat smaller. He is commonly 'found in the woods of Cayenne. He is a great de-'stroyer of game, such as the agoutis, akouchis, par-'tridges, pheasants, and other birds, whose young he 'seizes in their nests. He is very alert in climbing trees, 'where he conceals himself. He runs by a kind of leap-'ing; but his motion is not quick. In his aspect, gait,

'and manner of lying in wait, he has a perfect resem-
'blance to the cat. At Cayenne, I have seen several of
'them chained in the houses. They allowed themselves
'to be stroaked a little on the back. But they always
'retained a degree of ferocity in their aspect. They
'were fed with fish and meat, boiled or raw: every
'other food was disagreeable to them. They produce
'in all seasons, whether summer or winter, and bring
'forth two at a time in the hollows of corrupted trees.'

There is another tiger-cat, or rather a species of wild cat, in Carolina, of which the late Mr. Colinson sent me the following notice.

'The male was of the size of a common cat, being
'nineteen inches long from the nose to the tail, which
'last was four inches in length, and had eight white
'rings, like the maucauco. His colour was a bright
'brown, mixed with gray hairs. He was remarkable for
'pretty large black bars, along the body and sides, from
'the head to the tail. The belly is whitish, with black
'spots. The limbs are slender, and spotted with black.
'His ears have a large aperture, and are covered with
'fine hair. On each side of the nose, below the eyes,
'are two large and remarkable black spots; below these
'spots, and joining the lip, there is a tuft of stiff black
'hairs. The make of the female is more slender. She
'is of a reddish gray colour, without any spots on the
'back; but, on the belly, which is of a dirty white
'colour, there is a black spot.'

THE JACKAL AND ADIVE.

DOG of the form of a wolf, but much less. The colour is a bright yellow.

We are uncertain whether these two names denote animals of different species. We only know that the jackal is larger, fiercer, and more difficult to tame than the adive; but that in every other article, the resemblance is perfect. Hence the adive may be only the jackal rendered smaller, feebler, and more gentle than the wild race, by being tamed and kept in a domestic state; for the adive is to the jackal nearly what the lap-dog, or small water-dog, is to the shepherd's dog. However, as this fact is exemplified in a few instances only; as the species of the jackal is not in general domestic, like that of the dog; and, as differences so great seldom happen among free species; we are inclined to believe that the jackal and adive are really two distinct species. The wolf, the fox, the jackal, and the dog, though they approach very near each other, constitute four different species. In the dog-kind, the varieties are extremely numerous. Most of these originate from their domestic condition, to which they have been very early reduced. Man has multiplied the races of this species by mixing the great and the small, the beautiful and the ugly, the long and the short haired, &c. But, independent of these races produced by man, there are several varieties which seem to derive their origin from the climate. The English bull-dog, the Danish dog, the spaniel, the Turkish dog, the Siberian dog, &c. have received their denominations from the countries which produced them; and they appear to differ from each other more than the jackal does from the adive. Hence the jackals may have undergone several changes from the influence of different climates; and this idea corresponds with the facts we have collected. From the writings of travellers it appears, that the jackals every where vary in size; that in Armenia, Cilicia, Persia, and in all that part of Asia called the *Levant*, where this species is very numerous, troublesome, and noxious, they are commonly as large as our foxes, only their legs are shorter, and their colour is a brilliant yellow; from which circumstances they have been called the *yellow* or *golden wolf*. In Barbary, the East Indies, the Cape of Good Hope, and the other provinces of Africa and Asia, this species seems to have undergone several variations. In these warm countries, they are large; their hair is rather of a brownish red than of a fine yellow, and some of them are of different colours.

The jacard or adive is as large as a middle-sized dog, and resembles the fox in its tail, and the wolf in its muzzle. They are reared in houses; but their natural disposition is to conceal themselves, during the day, in the earth, from which they go out in the night only to search for food. They go in packs, put the men to flight, and devour the children. Their cries are plaintive, and a person is apt to mistake the noise they make for that of children of different ages mingled together. The dogs hunt and drive these animals from the habitations of men.—*Delon.* In Persia there is a species of fox called *schacal*, which the natives commonly denominate *tulki*. They are extremely numerous, and nearly of the size of European foxes. The back and sides are covered with a kind of coarse wool and long stiff hairs. The belly is white as snow, the ears black as jet, and the tail is smaller than that of our foxes. We heard them roaming during the night around the village where we had put up, and were much troubled with their

mournful and incessant cries, which resembled the voices of men in distress.—*Olearius.*

The addibo (*adive*) resembles the wolf in figure, hair, and tail. But it is smaller, and even less than the fox. It is an extremely voracious, but a stupid animal. In the night it roams about, and remains in its hole during the day. In the dusk of the evening nothing else is to be seen in the fields. These animals approach travellers, and stop to reconnoitre them, without any appearance of fear. They enter the houses and churches, where they tear and devour every thing they can find. Whatever is made of leather is a favourite morsel. The adive yelps like a fox; and when one cries, all the rest reply. This instinct of crying all together seems not to be voluntary, but to proceed from pure necessity; for when one of them enters into a house to steal, and hears the cries of his companions at a distance, he cannot refrain from crying also, and by this means detects himself.—*P. Fr. Vincent Marie.*

A chacali was kept for ten months in a house where I lived for some time. This animal has so great a resemblance to the fox in size, figure, and colour, that most travellers are at first deceived with it. The greatest difference between them is in the head, the chacali having a head like a shepherd's dog with a long muzzle, and in the hair, which is coarse like that of the wolf. Its colour is also similar to that of the wolf; and it sends forth a stench which infects every thing it touches. This animal is extremely bold and voracious. He is not afraid to enter the houses. When he meets a man, instead of flying instantly, like other animals, he looks at him with as much boldness as if he meant to brave him, and then runs off. He is very mischievous, and always apt to bite, whatever care is taken to soften him by caresses, or by giving him food. The one formerly mentioned, though taken when very young, and reared with as much attention as a favourite dog, was never rendered perfectly tame: he allowed nobody to touch him, and bit every person indiscriminately. He could never be prevented from leaping on the table and carrying off every thing he could lay hold of. All the country of Natolia is crowded with these chacalis. During the night they make a hideous noise round the villages, not only by barking like dogs, but by a certain sharp cry which is peculiar to them.—*Dumont.*

The jackal which the subjects of the king of Comania, near Acra, brought us, was as large as a sheep; but its legs were taller. Its hair was short and spotted, and its paws prodigiously thick in proportion to its body. Its head was also very thick, flat, and broad; and each of its teeth exceeded an inch in length. Its feet are armed with prodigiously strong claws.—*Bosman.*]

The species of the jackal is diffused over all Asia, from Armenia as far as Malabar, and is likewise found in Arabia, Barbary, Mauritania, Guinea, and the Cape of Good Hope. It seems to be destined to supply that of the wolf, which is wanting, or at least is extremely rare, in all warm countries.

However, as the jackals and adives are found in the same countries, as the species could not be degraded by continuing long in a domestic state, and as there is always a considerable difference both in the size and dispositions of these animals, we shall regard them as distinct species, till it be proved by facts that they intermix and produce together. Our conjecture concerning the difference of these two species is the better founded, as it seems to accord with the opinion of the ancients. Aristotle, after mentioning the wolf, the fox, and the hyæna, gives some obscure intimations with regard to two other animals of the same genus, the one under the name of the *panther*, and the other under that of *thos*. The translators of Aristotle have rendered *panther* by *lupus canarius*, and *thos* by *lupus cervarius*. From this interpretation, it is obvious, that they considered the panther and thos to be animals of the same species. But I demonstrated, under the article *lynx*, that the *lupus cervarius* of the Latins is not the *thos* of the Greeks. This *lupus cervarius* is the same with the *chaus* of Pliny, and with our lynx, which has not a single character that agrees with the *thos*. Homer, when celebrating the prowess of Ajax, who alone attacked a band of Trojans, in the midst of whom Ulysses found himself engaged, after being wounded, compares him to a lion, who suddenly falls upon a troop of *thos* collected round a stag at bay, disperses, and pursues them, as mean and dastardly animals. The commentator of Homer interprets the word *thos* by *panther*, which, he says, is a kind of weak timid wolf. Thus the thos and panther have been regarded as the same animal by several ancient Greeks. But Aristotle appears to have distinguished them, though he has not assigned to them different characters: 'The internal 'parts of the *thos*,' says he, 'are similar to those of the 'wolf. They copulate like dogs, and produce two, three, 'or four young, which are born blind. The body and tail 'of the thos are longer than those of the dog; but though 'the former is not so tall, he is extremely nimble, and 'leaps to a great distance. The lion and thos are ene-'mies, because they both feed upon flesh, and must, 'therefore, dispute about their prey. The thos loves 'men, and never attacks them; neither does he seem to 'be much afraid of them. He fights with the dog and 'the lion. For this reason the lion and thos are never 'seen in the same places. The smallest thos are the 'best. There are two species of them, and some extend 'them to three.' Aristotle says no more on the subject of the thos, and he says still less concerning the panther. It is mentioned only in one passage, namely, in the 35th chapter of the 16th book of his history of animals: 'The panther produces four young, which are 'blind at birth, like the young wolves.' From comparing

these passages with that of Homer, and those of other Greek authors, it appears to be almost certain, that the thos of Aristotle is the large jackal, and that the panther is the small jackal, or adive. We see that he admits the existence of two species of thos; that he mentions the panther but once, and when treating of the thos: it is therefore probable, that this panther is the small kind of thos; and this probability becomes almost a certainty from the testimony of Oppian, who ranks the panther among the number of small animals, such as the cats and dormice.

Hence the thos is the jackal, and the panther the adive: and whether they constitute two species, or but one, it is certain, that all the ancients have said, with regard to the thos and panther, applies to the jackal and adive, and to no other animals. If we have remained unacquainted with the true meaning of these names till now, it must be ascribed to the ignorance of the translators and of our modern naturalists.

Though the species of the wolf approaches near to that of the dog, yet the jackal is interposed between them. *The jackal or adive,* as Belon remarks, *is an animal between a wolf and a dog.* With the ferocity of the wolf he possesses a portion of the familiarity of the dog. His voice is a howling, mixed with barks and groans. He is more clamorous than the dog, and more voracious than the wolf. He never goes alone, but always in packs of twenty, thirty, or forty. They assemble every evening for the purposes of war, and of hunting. They feed upon small animals, and render themselves formidable to the larger species by their numbers. They attack every kind of cattle and poultry almost in the sight of men. They enter with insolence and boldness into the sheepfolds, the stables, and the cow-houses; and when they find nothing better, they devour the leather of the harnessing, boots, and shoes, and carry off what they have not time to swallow. When live prey fails them, they dig up the bodies of men from their graves. The inhabitants are obliged to stick the earth of their sepulchres full of large spines, in order to prevent these animals from scraping and digging; for a thickness of several feet of earth is not sufficient to prevent them from accomplishing their purpose. They go in packs, accompany this exhumation with mournful cries, and when once accustomed to human bodies, they never fail to frequent the church yards, to follow armies, and to attend the caravans. They may be considered as the ravens among quadrupeds. The most putrid flesh does not disgust them. Their appetite is so perpetual and so vehement, that the driest leather, skins, tallow, and even the ordure of animals, are equally welcome to them. The hyæna has the same taste for putrid flesh: it likewise digs dead bodies out of their graves; and from this practice these animals, though very different from each other, have often been confounded. The hyæna is a solitary, silent, savage animal, which, though much stronger than the jackal, is less troublesome, and contents itself with devouring the dead without disturbing the living. But all travellers complain of the cries, the robberies, and the gluttony of the jackal, which unites the impudence of the dog with the dastardliness of the wolf, and participating of the nature of each, seems to be an odious creature, composed of all the bad qualities of both.

[Jackals are in so great plenty about the gardens, that they pass in numbers, like a pack of hounds in full cry, every evening, giving not only disturbance by their noise, but making free with the poultry and other provisions, if very good care is not taken to keep them out of their reach.—*Russel's Natural History of Aleppo.*

Around Mount Caucasus there are many jackals. This animal resembles the fox. He digs dead bodies out of their graves, and devours animals and carrion. In the east the dead are interred without coffins or clothes of any kind. I have often seen large stones rolled upon graves, to prevent these animals from devouring the bodies. Mingrelia is infested with jackals. They frequently surround the houses, and make dreadful howlings: but what is worse, they make great havock among the cattle and horses.—*Chardin.*

THE ISATIS, OR ARCTIC DOG.

ARCTIC dog with a sharp nose; short rounded ears, almost hid in the fur; long and soft hair, somewhat woolly; short legs; toes covered on all parts, like those of a hare, with fur; tail shorter than that of the common fox, and more bushy. This animal is of a blueish gray, or ash-colour, and sometimes white. The young of the gray are black before they come to maturity. The hair is much longer in winter than summer, as is usual with animals of cold climates.

If a number of resemblances, joined to a perfect conformity of internal parts, were sufficient to constitute unity of species, the wolf, the fox, and the dog, would

form but one; for the resemblances are more numerous than the differences, and the similarity of the internal parts is complete. These three animals, however, not only constitute three distinct species, but are so distant from each other as to admit intermediate species. The jackal is an intermediate species between the dog and wolf; and the isatis is placed between the fox and dog. The isatis has hitherto been regarded as a variety of the fox. But the description given of it by Gmelin demonstrates it to be a different species.

The isatis is common in all the northern regions bordering on the frozen sea, and is never found on this side of the 69th degree of latitude. In the figure of the body, and the length of the tail, he is perfectly similar to the fox; but his head has a greater resemblance to that of the dog. His hair is softer than that of the common fox, and his fur is sometimes white, and sometimes of a bluish ash-colour. The head is short in proportion to the body; it is broad near the neck, and is terminated by a sharp muzzle. The ears are almost round. He has five toes and five claws on the fore feet, and only four on those behind. The penis of the male is scarcely so thick as a goose quill. The testicles are as large as almonds, and are so concealed with the hair, that it is difficult to perceive them. The hair over the whole body is about two inches long, smooth, bushy, and soft as wool. The nostrils and under lip are naked, and the skin of these parts is black.

In both male and female, the stomach, viscera, intestines, and spermatic vessels, are similar to those of the dog: there is even a bone in the penis of the male, and the whole skeleton resembles that of a fox.

The voice of the isatis partakes of the barking of a dog and the yelping of a fox. The merchants who deal in furs distinguish two kinds of isatis, the one white and the other of a bluish ash-colour. The latter are most esteemed, and their price advances in proportion to their blueness or brownness. This difference of colour is not sufficient to constitute a difference of species; for M. Gmelin was assured by the most experienced hunters, that, in the same litter, some of the young are white, and others ash-coloured.

The isatis is an animal peculiar to the northern regions. He prefers the coasts of the frozen sea, and the banks of the rivers which fall into it. He loves open countries, and never frequents the woods. He is found in the coldest and most naked mountains of Norway, Lapland, Siberia, and Iceland.

[It is probably by sailing on boards of ice that the foxes have found their way into Iceland, where they are very numerous. Some of them are black; but they are commonly gray or blue in summer, and white in winter; in which last season their fur is best.—*Anderson.*

These animals copulate in the month of March; and, their organs of generation being formed like those of the dog, they cannot separate for some time. Their rutting season lasts fifteen days, or three weeks, during which they are always in the open air; and afterwards they retire to their holes, which are narrow, very deep, and have several entries. They keep their holes clean, and make beds of moss in them. The time of gestation, like that of the bitch, is about nine weeks. The females bring forth about the end of June or beginning of May, and generally produce six, seven, or eight at a litter. Those which are to be white, are yellowish at birth, and those which are to be of a bluish ash-colour, are blackish, and their hair is then very short. The mother suckles and attends them in the hole during five or six weeks; after which, she makes them go out, and brings them victuals. In the month of September, their hair is more than half an inch long. At this period, those which are to be white, are almost entirely so, except a brown band along the back, and another across the shoulders. It is then that the isatis is called the *cross-fox*. But this brown cross disappears before winter, when they are entirely white, and their hair more than two inches in length. About the month of May, the hair begins to fall off, and the moulting is finished in July: hence the fur is good in winter only.

The isatis lives upon rats, hares, and birds; and, in seizing them, he uses as much address as the fox. He swims across lakes in quest of the nests of ducks and of geese, and eats the eggs and the young. In these cold and desert regions, he has no enemy but the glutton, who lies in ambush for him.

As the wolf, the fox, the glutton, and the other animals which inhabit the northern regions of Europe and Asia, have passed from the one continent to the other, and are found in America, the isatis ought likewise to be found there; and I presume, that the silver-gray fox of North America, of which Catesby has given a figure, is the isatis, and not a simple variety of the fox.

END OF VOL. I.

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